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AVIATION

The Oldest American Aeronautical Magazine

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ANSWERS A QUESTION:

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We advertise to make more widely known the fact that pioneering in aircraft design and construction has been our tradition since the earliest days of practical aeronautics. We advertise to spread knowledge of the improvements we have made, and are making almost daily, in our planes.

We advertise to create confidence in our ability and in what we have to sell, for in aviation as in almost no other industry the ability of the manufacturer is the key to the merit of his product.

As a result, many Martin built planes such as the Pan-American Clippers are in daily scheduled passenger service. They are doing *their* part in the job of selling the world on the idea of travel by air by setting new standards of safe, dependable operation."

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AVIATION

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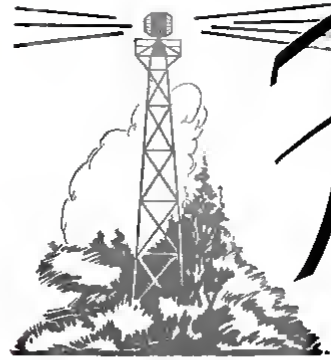


Flashes

From the Skyways of the World

» LAST MONTH we sounded off editorially on the problem of getting the Army and Navy to file flight plans when flying over airways. Now it seems that it may be necessary to extend the idea to include the builders and "pilots" of gasoline driven models. Not long ago an airlines pilot flying along between New York and Washington at 5,000 ft. got something of a shock when he saw one of the miniature ships flying merrily along beside him. (We won't strain your credulity by insisting that the model was keeping abreast of the Douglas, but it *was* up there, according to the flight report.) Later, the model came down near Trenton, and, we hope, was returned to its owner. But the incident suggests what may happen if model owners put in an "eyedropper" too much fuel in their tanks.

» AND THERE IS PLENTY OF INTEREST these days in the power driven models. A race meet of the model builders may often turn out to be much more exciting than one of the Henderson Boys' shows. Not long ago we had an opportunity to visit Major Moseley's "Baby Cyclone" manufacturing plant at Glendale, and his "assembly line" looked like a small scale Ford plant. And the test stands were really something! With three or four of the midgets going at full throttle the effect was the same as a "fly-by" of a whole pursuit squadron. We came away with a distinct feeling that we were going to get one of those little gadgets to play with some day.

» ALTHOUGH WE SAID LAST MONTH that this was not a book review department, here are a couple that we can't let go by without comment.

Clara Studer (formerly of The Airwoman) has turned out a perfectly swell job in her *"Sky Storming Yankee"* (Stackpole and Sons, N. Y.)—the story of the life of Glenn Curtiss. She obviously did a vast amount of rooting about in dusty newspaper files and through ancient correspondence, but the result is far from dull or dusty. She tells the story of the early Hammondsport days (and later) in a way that makes Curtiss and his associates move and act as human beings. Excellent reading. We recommend it.

The other, Howard Mingos' *"Aircraft Year Book"* (Aeronautical Chamber of Commerce, N. Y.) is of a totally different type, but no less interesting. In its fifteen chapters Howard has done his usual competent job of reviewing the accomplishments of the aircraft industry in America. There is very little that he misses in his annual surveys. We can't agree with him on his estimates of European air strength (we published our own estimates in our April issue), but that is beside the point here. The book is a "must" for any aeronautical library worthy of the name.

About this issue . . .

The airline story-of-the-month this time concerns United, and we must acknowledge our indebtedness to Bob Johnson and other members of the line's personnel for their help in getting out the material. . . . Smoke usually means waste, but Lt. Mackey tells how he found ways to make smoke pay a profit. . . . Mr. I. W. Wood is an architect who has studied airports here and abroad. His article in this issue is the first of three on airport problems. Shortly, he is publishing a book on the subject. . . . With this issue Commander Weems is beginning a series of lessons in aerial navigation "written so you can understand it." . . . Shanley and Ryder, out of their long experience on stress analysis, present a new method of computing complicated "combined" stresses in aircraft structures. . . . Then we have the story of a couple of really big airplanes, the latest Boeing bomber and the British Empire class.

» We are thinking about setting up a vital statistics column in this department. At any rate, a couple of items have dropped in that are distinctly eligible. Number one concerns an addition to our West Coast editorial staff, Elizabeth Ann McReynolds, brand new daughter of Mr. and Mrs. C. F. McReynolds. "Mac" sent us a specification which reads just like a Flying Equipment Department item. Then Ray Quick, formerly of the Bureau of Air Commerce, and author of an article on propeller brakes in our December 1936 issue, is also a proud

papa, also of a girl. According to the Roosevelt Field News, mother and daughter are doing very nicely and Ray is getting on as well as can be expected."

» One of our big airlines makes a specialty of serving real southern fried chicken at meal times aloft. We can vouch for its excellence, too, for we've tried it several times recently. But ask any pilot or copilot on the line what he thinks of fried chicken! After getting it twice a day—day in and day out—they say they can scarcely look a chicken in the eye nor even contemplate an egg without a shudder.

» The Air Express Division of the Railway Express Agency has gotten out a folder called "How to Profit with Air Express." It gives rates and schedules and lists advantages for a number of types of shippers. Free for the asking.

» Nearing completion on Cheyenne Mountain just south of Colorado Springs, is a memorial to Will Rogers. The building is of granite, in the form of a feudal castle, and will carry on top of its hundred foot spire a sodium airways beacon. It is the gift of Spencer Penrose of Colorado Springs, as a suitable memorial to a great American who was one of our greatest boosters for aviation.

» In talking about the airlines in Europe lately we have pointed out that hostesses on KLM must pass all the specifications which our own girls must meet, but in addition must be able to handle three or four languages besides their native Dutch. First line over here to set up any such require-

"Maguire got himself a cabin job."

ment is Braniff. Candidates for flight stewardess positions on the new Douglases which will go into service in June must be registered nurses, not over 26 years of age, not more than 5 ft. 4 in. tall and under 118 lb. Besides English, they must speak Spanish fluently. This, of course, to make Mexican and Central American visitors coming into the states via Brownsville, feel perfectly at home.

» Charles Babb, California's big dealer in used airplanes, pulled into Floyd Bennett the other day from Yucatan where he reported selling a Boeing 247 for rather novel use. Seems that a lumbering operation had a problem of getting mahogany logs out of the jungle and into a lake for floating out to civilization. Although not far from the native heath to the lake the route lay over impenetrable forest—impassible on the ground. Latest scheme is to modify the bottom of the 247 fuselage so that one of the huge logs may be slung under it, flown out of a clearing, released over the lake.

» A smart Pontiac dealer of Glendale, Cal., has worked out a delivery scheme for cars whereby the customer is given a trip back to the Michigan factory, over United Air Lines, takes delivery of the new car and then makes a choice of several routes home. Ray Corrigan points out that the cost of the trip—including air transportation, meals, gas and oil—is about the same as the freight delivery charge on the car laid down in Glendale.

Side Slips

By ROBERT OSBORN

» We are continually amazed by the new accomplishments of airplanes—just the other day a Nevada sheriff caught a fleeing suspect who was sighted from an airplane. Of course we know that airplanes have been used for years by officers of the law to hunt for escaping bank robbers, kidnapers and car thieves, but as they

never caught anybody by that method we thought they were just using a good excuse for some free airplane rides

» We had been wondering if the man who used to select names for Pullman cars was unemployed, with the building of new cars stopped by the depression. Now we know that he managed to find another position in England as the names announced for the twelve new Imperial Airways Airliners are Ensign, Eddystone, Elsmore Ettrick, Explorer, Egeria, Euterpe, Endymion, Euryalus, Elysian, Empyrean and Echo

» We see by the papers that the first Intercollegiate Air Meet was held recently with six colleges and universities entered, and with the University of Pennsylvania as host. Competing events in the meet consisted of paper straffing, bomb dropping and spot landings.

Being familiar with the activities of college students on and off the campuses, we were surprised that they did not include competitive events in which they might have shown even greater skill, such as in stalling along, blind-date flying and sky writing of "Please send check."

» Now that the Spanish battleship "Espana" has been sunk by a bomb dropped from an airplane, we think it would be worth while for some promoter to put on the fight between the airplane and battleship boys in Madison Square Garden—he could be sure of a top of $40 to $50 for ringside.

If the late Arthur Brisbane were available we'd put our money on the airplane contingent, but so far the "Airplanes Can't Sink Battleships" group has had all the best of it in the newspapers. Their arguments have stressed the following points, so far as we can make them out.

1. The airplane dropped the bomb down the funnel, which isn't considered cricket.
2. The bomb struck on the after deck where the armor was only one and a half inches thick.
3. The Espana was an out-dated battleship, being "over age" (Let's see now, how many of our battleships do they say are over age?)
4. The Espana had no water-tight compartments, and the bombers were poor sports in picking on a battleship with that handicap.
5. Somebody probably just lit a cigarette in the powder magazine.
6. It was just a lucky hit anyway.
7. It wasn't the Espana which was sunk, just a disguised merchantman.

» Somebody, it seems, is always doing something to take all of the romance out of flying. A little while ago somebody was designing an airplane to spread fertilizer on large farms, and now the Army flight surgeons issue

an order the aviators must remove all false teeth before starting on flights. How are we going to maintain the impression among the fair sex that all fliers are reincarnations of Apollo and Hercules with news items like these in the papers?

» The Army Air Corps announces that it will accept recruits for training in the following ratings,—airplane and engine maintenance, armament worker, radio operator and mechanic, sheet metal and welding machinist, meteorology, parachute rigging, clerk, aerial and ground photography, automobile mechanic, steward, and cook.

We suppose that the man whose job it is to leave the gas tank cap off, a pair of pliers on the seat, a dab of grease on the controls and a spray of oil on the windshield, is available to the Air Corps from the automobile service stations, already trained.

The Hindenburg

THE HINDENBURG IS GONE, and the manner of her passing was so swift and so terrible that even yet we can scarce believe that it happened One minute she was there,—serene, safe, solid. The next,—literally,—she lay a shapeless mass of incandescent junk at the foot of the mooring mast where hands, still outstretched, were waiting to receive her

Now, in stunned Lakehurst, investigating boards have convened The greatest airship men in the world—Eckener, Rosendahl, and a dozen others,—study countless photographs, hear the testimony of hundreds of eye-witnesses Expert investigators peer and pry through tons of twisted girders, twisted wires Static electricity? Structural failure? Backfire? Sabotage? These are the questions that they must answer, not only for their own satisfaction, but before the world For the whole world sits, as a coroner's jury sits, over the battered remains of the fallen giant

But the answer the world seeks is far broader than the immediate cause of the disaster Too well it remembers the DIXMUDE, the ROMA, the SHENANDOAH, the R-101, the AKRON and the MACON As the HINDENBURG S name is added to the roll, questions arise everywhere Is the game worth the candle? Is there justification for the heavy cost in lives and in effort? The airship itself is on trial for its life

Already voices are being raised from opposing camps Germany, with flags half-masted for the recent dead, announces that the work on the new LZ-130 will be pushed to completion as rapidly as possible, that transatlantic schedules will be resumed But in Washington, our military people announce the complete abandonment of all lighter-than-air work At Lakehurst, the LOS ANGLES, once the Navy's pride, quietly rots away at her moorings And Congress, viewing the record, shakes a dubious head over ever again making funds available for airships

In the face of all the troubles that have beset airships in the past, however, we are not yet persuaded that the lighter-than-air craft has no useful place in the future pattern of commercial air transport We believe that it would be an irreparable mistake to toss all the hard-earned experience to the winds, to close the door forever on lighter-than-air development at this stage With centuries of ocean navigation behind us we still have our TITANICS and our MORRO CASTLES, but we still build our QUEEN MARYS

and our EUROPAS. It is far too early to be dogmatically certain that this or that form of aircraft is the final answer. It seems not impossible that a variety of forms will be evolved to fill a wide range of specific uses. After all, we are only on the threshold of the era of transportation by air, and, in spite of the tremendous progress of the last decade, the surface of the problem has scarcely been scratched.

But whatever direction development takes, Lesson Number One stands out clear and stark. We learned it years ago with the destruction of the ROMA, and it has now been seared into the minds of the world by the pillar of fire that was the HINDENBURG. Never again must commerce in the air be carried by hydrogen. For the present, airship development should be confined to structural and aerodynamic laboratories until an adequate supply of helium or other inert lifting gases be made available to all. We cannot offer any solution of the complicated chemical and economic problems involved, but we are certain that the use of non-inflammable gas is the *sine qua non* of airship work in the future.

Now, still stunned and shaken by the tragedy of the HINDENBURG, we can only await the verdict of the investigating boards. Their findings will, to a large extent, determine the future of the airship all over the world. As matters stand, the whole case for lighter-than-air rests only on the record of the ageing GRAF ZEPPELIN.

For American aviation and for ourselves, we extend to the German nation and to families and friends of those who lost their lives on the field at Lakehurst our most profound sympathy.

More and Better Weather

IN CRUISING ABOUT from airport to airport and in talking with our pilot friends, private and professional, we are continually coming across a species of complaint that is definitely too commonplace to be ignored. Of course, all pilots like to "beef" about this and that, but when the same "beef" comes up time and time again, from Maine to California, there must be something there to "beef" about.

"Why can't we get accurate weather reports at airports?" is the burden of their cry. At airports, of all places, where personnel is constantly on the watch, where all sorts of instruments for observation are installed, it would seem that accurate information should be available. Yet pilots are constantly reporting (a) that they have been refused permission to land on fields because of alleged low ceilings when they themselves could see the field from altitudes well above the prescribed minimum, or (b) they have been given clearance to land with adequate ceilings reported, only to find on arrival that even the airport penguins were strolling about on the ground.

[illegible]er situation is desirable. The first [illegible]yance and confusion, and the second positively dangerous.

The only possible assumption seems to be that airport weather personnel generally are either careless or incompetent. Neither is excusable. Airport managers and the Bureau of Air Commerce should immediately take steps to clean up all such situations. If necessary, get better men by paying them more; if necessary, provide better equipment and increase the number of daily observations. Surely all pilots coming in from runs deserve to know exactly what conditions they will meet at destination. Nothing short of 100 per cent accuracy in airport weather reporting can be tolerated.

Ten Years After

TWICE IN THE LAST FEW MONTHS Dick Merrill flies a round-trip over the Atlantic. Less spectacular than his first, his second trip was a competent job of work, carried off in a professional manner. To him, to his co-pilot, and to the makers of the equipment he used, our congratulations.

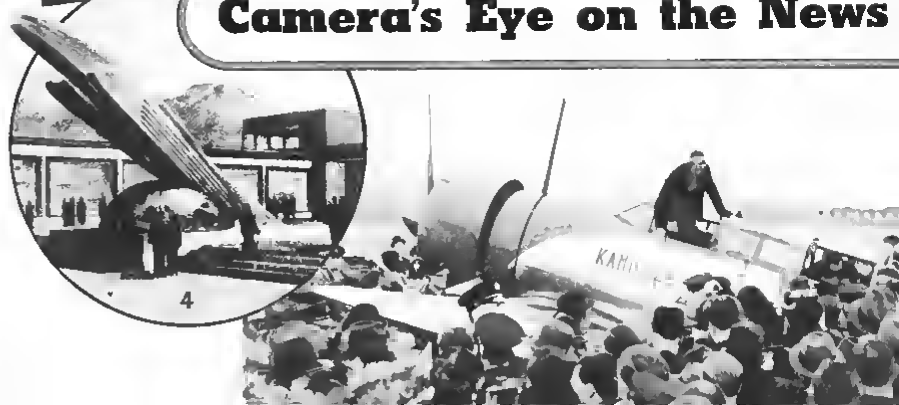
But we cannot help but contrast his performance, excellent as it was, with that first New York to Europe flight whose tenth anniversary is being fittingly celebrated this month. Alone, with a type of equipment that few would care to risk their necks in today, Charles Lindbergh wrote a page in aviation history that will probably never be matched. The world did well to acclaim his flight in 1927 as few events in modern times have been celebrated.

Merrill's flights of 1937 far and away exceed Lindbergh's record in speed, distance, and commercial significance, but as far as we have been able to discover no one suggested submitting Merrill and Lambie to a Broadway Triumph. Although an Atlantic crossing is still headline material for a few days, yet we think it is significant that they are well on the way toward the commonplace. Before many years go by, transoceanic plane movements will, and properly, be relegated to the shipping news pages.

Real progress this, and of the sort of which the whole aviation industry and all its associated interests may well be proud. Pan American's experience in the Pacific, and Imperial's rapidly developing Empire services, are all pointing the way. The pioneering days are almost over and we are at last settling down into a period when commercial ocean crossings will be as safe, comfortable, and commonplace as any overland flight.

1. End of the Hindenburg at Lakehurst (Wide World). 2. The Army spreads its wings over California (Air Corps Photo). 3. PAA's Juan Trippe receives flying permits for the North Atlantic route from Secretary Roper while Free State Minister MacWhite and Sir Ronald Lindsay look on (Wide World). 4. The aviation monument at the Paris Exposition. 5. The Japanese-built "Divine Wind" lands in London after a 94 hour flight from Tokyo (Wide World). For further news see page 48.

Camera's Eye on the News



Safety through Research

United's operating policies are backed by its laboratories

THE STORY of Thorp Hiscock is no more the full story of United Air Lines than Knudsen's history is the history of General Motors. But Hiscock has definitely left his mark, for his was the type of mind that was never satisfied with things as they are. He was always reaching out for something better. And he instilled into United a spirit of research that his successors have never lost.

Nor was Hiscock's influence confined to United. His brilliance and flexibility of mind and his great energy and tenacity led to contributions to air transportation in general which might not have been forthcoming for years. Thus, in 1928, when Boeing Air Transport had been attempting to get a practical installation of two-way radio telephony for plane-to-ground communication, but without much success, Hiscock (a former army pilot deeply interested in radio, retained to tackle the problem) disagreed with theories that short-wave voice radio could not be applied successfully to aircraft. He started work with a transmitter mounted on an automobile and a receiver located in the Boeing factory. When he felt that he had that much of the problem licked, he transferred the receiver to an airplane that had been bonded and shielded under his supervision from the earliest stages of assembly. With Edmund Allen (well known to readers of AVIATION, then test pilot for Boeing) he worked the "bugs" out of the system in the air and then turned the apparatus over to an equipment manufacturer for commercial development.

Again Hiscock contributed much to the solution of problems concerning development of the constant speed propeller and the modern automatic (gyro) pilot. In his laboratory was done some of the work that led to the perfection of the present type wing de-icer. Automatic mixture control, designed to supply proper fuel mixtures to engines at any altitude was also one of his conceptions. United Air Lines and air transportation generally, suffered a great loss with Hiscock's untimely death in the Spring of 1934 as a result of a heart attack.


Engineering and Maintenance Superintendent Oliver West

Fortunately, however, capable men were at hand to carry on his work. With the greatly expanded activities of United, two men have taken over—Oliver West as superintendent of engineering and maintenance and Russell Cunningham, superintendent of communications.

In engineering and development West is well qualified for his job. He entered aviation 15 years ago in the production department of the Boeing Airplane Company and after several years of service (during which time he became production manager) his interest in operations led him into United. Few men in the industry are more respected for their knowledge of airplane maintenance and the problems pertaining thereto. But his job goes far beyond the routine care of existing equipment. His most important work lies in the much broader field of the development and specifications of new airplanes, new engines and new flying accessories, and all related problems that bear upon airline safety and economy.

Above: When United Air Lines went Twin Row—First 14-cylinder Wasp to the Cheyenne overhaul base. Left: Two busy airline executives take time out for dinner—Vice President Crary (left) and President Patterson (right)

Cunningham, now in charge of radio development, learned to fly in the army during the war, was a forest patrol pilot in Oregon and then flew the mail in the old Pacific Air Transport, a predecessor of United in that territory. In 1930 he became chief pilot of United's Pacific Coast Division and was shortly advanced to the position of assistant to Thorp Hiscock. He has always been vitally interested in radio and electrical problems and is especially well qualified for his new job.

One of United's most important units is the research and communications

(Turn to page 70)

MONEY in **Smoke**

Aerial advertising pays a Comfortable Profit to the Linco Flying Aces.

By Lt. Joseph C. Mackey
General Manager Mackey Flying Service

The author who holds the Freddie Lund trophy for precision acrobatics. Upper left: A three-plane acrobatic smoke exhibition by the Linco Aces.

BACK IN THE HAPPY DAYS OF 1929 you could sell anything to an oil company. But gas wars, taxes, and other refining industry problems have made petroleum producing executives as hard boiled as a typical small town banker during the famous holiday of 1933. That's why we are proud of our exclusive contract to plaster the skies with the name of the Ohio Oil Company. We have been doing this job for two years now to the exclusion of all our other activities. And it keeps us so busy that we have to turn over about half our requests for performances to smaller operators during the air show season.

Skywriting, banner towing, sign carrying are all part of the day and night work of our outfit and all six of our ships carry the red and white colors of the refiners of Linco oil products. My own ships are a specially streamlined taper-wing Waco having a top speed of 200 m.p.h. for low inverted acrobatics and a 250 m.p.h. Laird Super Solution (No. 77) for high speed exhibitions.

CARL MIDDLETON flies a 300 Travel Air Speed Wing for skywriting and aerobatics and a Wasp powered Laird Speed Wing. For banner towing and skywriting, a 300 Waco is flown by Edward S. Leach. The night flying billboard is a Curtiss-Wright Fledgling piloted by W. Myron Hightower.

Ten complete air shows and a number of other appearances are scheduled for 1937. Frequently we have to appear at two shows in cities as much as 100 miles apart in the same day. When we accept an engagement we furnish our own announcer and publicity director, Mr. William Sweet, Jr., and our public address system installed in a custom built Dodge panel truck. We also furnish posters advertising the meet and a newspaper advertisement if necessary. We prefer to have some reputable local organization sponsor the show, arranging for the field, concessions, tickets, patrol work and publicity. Naturally we insist on having our own tank trucks on the field to service our planes.

In the course of our work we have developed a number of aerial advertising innovations. A notable example is our multi-ship sky writing, in which we use two or three airplanes simultaneously. Our smoke formula is the result of several years of development in which many substances were tried. We even used molasses in some of our experiments.

Chemicals are mixed with a light paraffin oil carried in the wing tanks. The compound is forced from the tanks by an engine booster pump through small pipes to the hot exhaust manifold where it is vaporized and forced out by the exhaust.

Before taking off, a diagram of the words to be reproduced is made and mounted on the instrument board for the pilot's guidance. Block letters, easier to make than script, are usually about a mile high and one quarter of a mile wide. One of these letters consumes about a gallon of oil. Script letters are more difficult to produce but Pilot Leach, of our troupe, is a specialist in this type of skywriting. All skywriting is done with the ship climbing to enable the smoke to stick and to slow up the plane. In making a ten letter sign, the ship will finish 500 ft. higher than the starting point.

Two Linco planes belching smoke in a demonstration flight by the author and Pilot Edward Leach.

THE SIGN CARRYING FLEDGLING carries the neon illuminated letters "LINCO GAS-OIL". During 1936 Pilot Hightower flew it 250 hours, mostly over uncharted airways. The Fledgling also carries equipment for skywriting and launching aerial banners.

During 1936 we performed before more than two million persons in 69 appearances. In the past five years we have entertained more than six million persons, dedicated 25 Ohio and Indiana municipal airports, have appeared in six newsreels and one movie short and have injured no one.

In addition to my work with the Linco Flying Aces, I have made a number of personal appearances in this country and abroad. A year ago it was my privilege to represent America at the International Air Games in Paris. The enthusiastic reception tendered by the French people was a source of great pleasure to me.

Under the smoke screen,—a solo demonstration by the author.

Airport or... White Elephant?

World's busiest airport, Newark, had to be extensively modernized at great cost.

Which you get depends on how you plan from the outset

By John Walter Wood

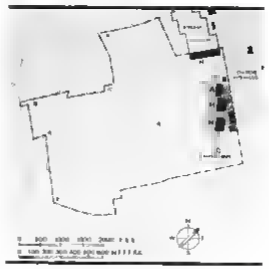
The first of three articles on comprehensive airport planning

THE RAPIDITY of expansion in air transportation has already created a critical situation at those airports situated at the more important focal points of surface and air transportation. The technique of planning ground facilities has not kept pace with the rapid expansion in the air. The planning of airports, as was the case with the planning of railroads and of automobile highways in the early days of surface transportation, is passing through a costly period of trial and error at a reduction in efficiency and at an unnecessary increase in cost.

Airports are as important to the airplane as roads are to the automobile. Realization of this fact has resulted in a hurried attempt to supply the conditioned land and a suitable number of airports. Two hundred and twenty-five million dollars (Estimated by Bureau of Air Commerce as of January 1, 1937) has been spent on civil airports, many millions of this amount having been voided through inadequate airport planning sometimes necessitating the razing of a line of hangars, the changing of the whole airport layout or the obsolescence of entire airports. Most airports are going through a partial or drastic modernization made necessary because of incomplete initial planning. Hangars designed without provision for increase in clear door height and in floor area originally built to house light planes of small dimensions are proving inadequate to accommodate the large transport planes of today. Airway stations originally designed to care for a few dozen passengers a day are proving incapable of caring for the hundreds of passengers they are required to accommodate.

The haphazard, hit-or-miss airport program has proved inadequate for present needs and has been characterized by lack of flexibility of design in the provision for future expansion. This unsatisfactory situation will continue until, as in other lines of activity, experts are called in to plan the entire airport layout at the outset and to synchronize the airport with existing and future surface transportation and city planning. With proper principles of unit design and layout determined, airport construction might proceed without periods of incapacity and wasted capital.

MUCH has been learned about grading, drainage, runways, lighting, blind landing systems, hangars, airway stations and airport management—but to date they have not been crystallized into a pattern at once the most effective and economical. Important centers of population should normally concentrate their air transport activity at one or at a few, rather than at many airports, but this is only possible when adequate airport design provides for the simultaneous accommodation of large numbers of planes with maximum efficiency and minimum of waste motion. Without a comprehensive solution of the problem many cities are planning to build new airports or to improve existing facilities. Unanswered however, are certain fundamental questions. Are they the best that can be installed for the same amount of money and labor? Are they adequate for present needs and will they meet the necessary requirements, five, ten, fifteen years from today?



The earliest method of establishing an airport was for a community to set aside a level tract of land and call it an airport. Some of the early fields were satisfactory so long as flying was confined to small numbers of light planes operating in fair weather. But with the advent of heavy transports weighing eight or nine tons, (—and tomorrow, twenty tons) operating on schedule winter and summer in virtually all kinds of weather, the need of making blind approaches to the airport and the unexpectedly rapid increase in the volume of commercial air traffic have quickly rendered these early landing fields obsolete.

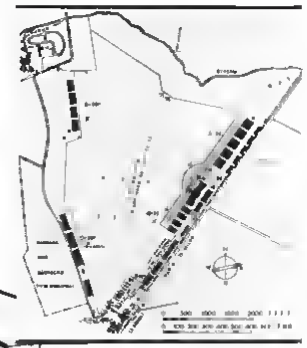
WHERE formerly natural drainage on the landing area might have been found sufficient it has become necessary in some cases to underlay the landing area with over two hundred miles of drainage structures, which in certain instances have been crushed or pressed out of alignment by the traction of heavy transport planes passing over them, turf or soft surfaced runways have had to be replaced by hard surfaced runways resting on more substantial foundations.

Other important modifications at airports govern the airport zoning requirements. In the past the zoning of the obstructions in the marginal areas about airports has been determined by the use of an allowable safe climbing ratio (the number of feet of horizontal distance travelled for each foot of height in climbing) of 1 to 10 minimum for transport planes.

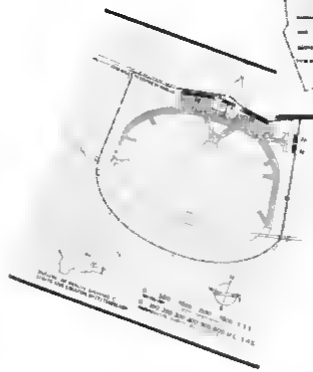
An indication of the critical situation existing at the more important commercial airports will be shown by citing specific examples from conditions at the commercial airports of New York, Paris, Berlin and London (See accompanying airport plans and photographs).

New York's commercial airport at Newark, N. J. has developed from its inception without the benefit of a well conceived and comprehensive airport

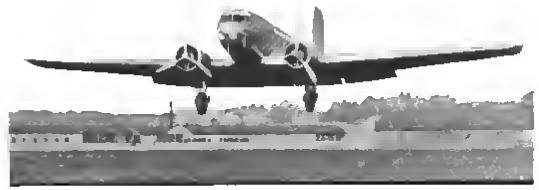
(*Turn to page* 75)



The landing area at Le Bourget (above) is being doubled, and dozens of airport buildings must be demolished in the process.



When Croydon (left) was first expanded, a cluster of buildings turned up in the center of the new airport. The same thing is happening at Tempelhof (above).



AIR NAVIGATION

Finding Your Way in the Air

I. AIR PILOTAGE

By
Lt. Comdr. P. V. H. Weems
U. S. N. Retired

AIR PILOTAGE is the method of directing aircraft from place to place by referring to visible landmarks on the earth's surface, such as mountains, lakes, railroads, and beacons. The essential equipment for this method is a suitable map. Since this extremely important item is required for all methods, it will be discussed at this point.

There are many types of charts and maps in use for various purposes, but for air navigation, these might be classed as *Mercator*, on which the latitude and longitude lines are perpendicular, and on which the compass course appears as a straight line. Unfortunately, the distance scale is variable, being the expanding scale of latitude measured at the mid-latitude. While these charts comprise more than 95 per cent of those used at sea, they are being partially replaced in the air by the Lambert Conic Conformal projection described later.

Gnomonic, or Great Circle charts, on which the great circle track appears as a straight line, but with the latitude lines (except the equator) being neither straight nor at right angles to the meridians, and for which there is no convenient distance scale. The meridians of longitude are straight lines.

Conic or *Polyconic* charts on which the earth's surface is developed on a cone or series of cones. On polyconic charts, the latitude lines appear as circles with decreasing radii to the north, and with all longitude lines except the middle one curved. The distance scale is fixed, and may be used over the entire chart. Since the longitude lines are not parallel to each other, a compass course will not appear as a straight line.

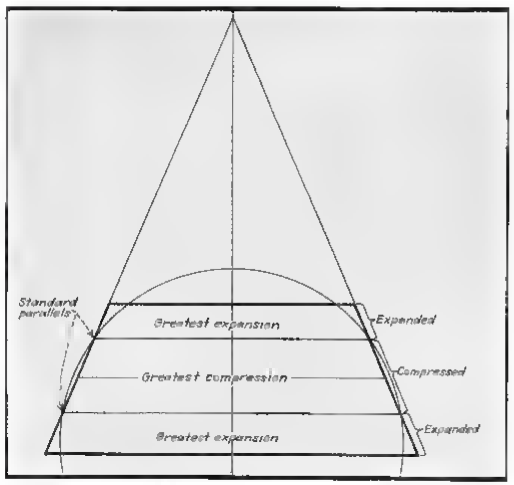


Fig. 1: Principle of Lambert projection.

The type of chart of greatest present interest to aviators in this country is the Lambert Chart which includes the Sectional and Regional Aeronautical Charts published by the U. S. Coast and Geodetic Survey. Lambert charts are developed on one cone which cuts the earth's surface along two standard parallels, so that the longitude lines are straight and perpendicular to the latitude lines which appear as concentric circles. The earth's surface is projected without distortion at the two standard parallels so that the errors are distributed, with the area between the parallels compressed, and the area outside of these parallels expanded.

Since it is impossible to project a spherical surface on to a flat surface without distortion, it is the map-maker's concern to produce maps with the least distortion, and with features of greatest advantage to the aviator. While the Mercator chart with straight rhumb line or compass course has a tremendous appeal to many navigators, the Lambert charts with *fixed scales* of *distance* and with the great circle course appearing as nearly a straight line, so that radio bearings may be plotted without conversion, will doubtless replace most other types in the air. An additional important feature of the Lambert Chart is the fact that adjoining sections fit exactly along the borders so that strip maps may be constructed from sectional maps, or large maps made by joining them together. For further details of Lambert Charts, see Publication 197- U. S. Coast and Geodetic Survey. Fig. 1 shows the principle of the Lambert projection, while Fig. 2 shows the appearance of the chart.

It will be noticed in Fig. 2 that in going from *A* to *B* on a direct course the initial course is 41 deg. while the course steered on approaching *B* is 73 deg. This variation in the true course is due to the convergence of the meridians. The course measured at the mid-meridian is the mean course 58 deg. which would be about the same as the Mercator course shown by the dotted line. The straight line *AB* is close to the great circle tract, and this is closely approximated in practice by setting a new compass course at intervals of two or three degrees of longitude, and measuring the new course each time at the mid-meridian for that leg. It will be noticed that the scale distortion at the worst part of the chart covering a large area in Fig. 2 is only 2½ per cent., and in most cases, this error would be reduced by compensating errors.

WE ARE FORTUNATE in having the Government publish aeronautical charts of a uniform nature, with map symbols conforming to the international map symbols, and at low cost.

International Aeronautical Maps consist of the following series:

Basic Aeronautical Maps, on the Mercator projection to the scale of 1:10,000,000 at the Equator, and extending to latitude 72 deg. with the Sterographic Projection for areas above latitude 72 deg.

Itinerary or Route Maps, scale 1:10,000,000 on the oblique true projection on a cylinder tangent along the great circle route.

General Aeronautical Map, scale 1:3,000,000 on the Mercator projection and extending to 68 deg. of latitude north and south.

Local Aeronautical Map, same as the *International Map of the World* with aeronautical features added. Scale 1:1,000,000 and on the Lallemand projection in which two standard meridians are used instead of two standard parallels of latitude as in the case of the Lambert projection. These maps have an accurate distance scale and are known as the 1/M maps. They are available for a large portion of the earth's surface at this time. While not conforming exactly to the international series, the U. S. Regional Aeronautical Charts are considered a part of the international series.

These international maps are published by the International Commission for Air Navigation (I. C. A. N.) which came into force in 1922, and which has its headquarters at 15 bis, rue Georges-Bizet, Paris, France.

British Ordnance Survey Maps include maps of Russia, India, the British Isles, Africa, and other portions of the British Empire. They are published by the Ordnance Survey, Southampton, England.

Shell Aviation Route Maps and Pilots cover the routes from London to Melbourne and London to Cape-Town and include the best available data in an attractive form for these routes. They do not attempt to replace the regular aviation maps, but include accurate sketches of landing fields, with data on weather, dangers to aviation, emergency landing fields, gas facilities, etc.

Aids to Navigation assist the navigator in accomplishing air pilotage by giving him more definite and better charted landmarks. These aids include the established airways, with Government and private radio (discussed later) and beacon light facilities. Such rapid progress is being made in the construction of aids to navigation, and so many changes are made in them from time to time, that the successful navigator must give serious attention to supplying himself with the latest available data. In this connection, full use should be made of the Government facilities available to the public without charge, or with only nominal charge.

Before starting out on a flight spread out on a table and study carefully the map to be used, and make sure it is the proper one to use. A good plan is to draw the course and mark off on it convenient intervals of say 20 miles, and in addition, to draw two course lines ten degrees each side of the desired tract course as a means for estimating errors off course. Then

(*Turn to page 76*)

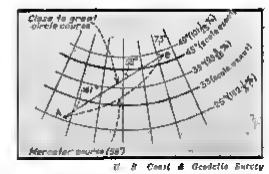
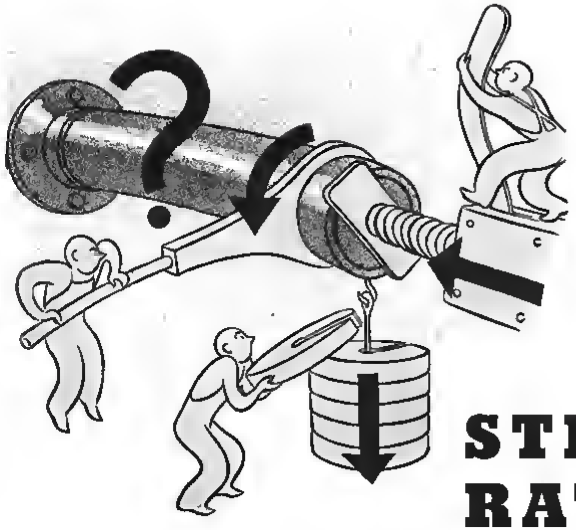


Fig. 2: Scale distortion of the Lambert conformal conic projection with the standard parallels at 33° and 45°.



STRESS RATIOS

The Answer to the Combined Loading Problem

By

F. R. Shanley and E. I. Ryder

Although not writing in their official capacity as engineers on the technical staff of the Bureau of Air Commerce, the authors have made use of their intimate understanding of aircraft structuree in attacking one of the most annoying of the "stress-man's" problems. Comment and criticism will be welcomed by the authors and should be addressed to them in care of AVIATION.

FOR SOME REASON aeronautical engineers seem to get more than their share of combined stress problems. Whether this is due to the complexity of aircraft structures or to the refinement of analysis methods forced by the economics of weight-saving, fact remains that the problems exist and must be solved somehow. In most cases they are solved as individual problems; sometimes a few tests are made, or perhaps a formula is pulled out of a dusty textbook. Or maybe the conditions are simply ignored—the "ostrich" method of solution—a great time-saver for the engineer and a nice method when you can use it. Scarcely a weight-saving method, however, although it may appeal to the gambling instinct.

In working on the Army-Navy Commerce Materials Handbook recently we tried to uncover all the useful information on allowable combined stresses. The result was disappointing, to say the least. Apparently most people who have interested themselves in structural theory have been unaware of the fact that simple stresses are seldom to be found in aircraft structures. About the only attempts to find out what happens when you mix things up a bit have been made by engineers actually faced with the problems, or by people in close touch with the aircraft engineer's difficulties. No doubt a great deal of work is embalmed in the scrap books of the "stress men," who usually don't have time to polish up their work and reveal it to the waiting public, or perhaps they think it's a trade secret.

As far as the authors are concerned, the story begins with *N.A.C.A. Technical Note No. 307* (Ref. 1), and ends with Timoshenko's *"Theory of Elastic Stability."* In between are many contributions by many authors, most of whom will be mentioned in connection with specific cases.

For want of a better term, we call our system of determining the allowable loads under combined loading conditions the *stress-ratio* method. It is non-dimensional, as it deals only with ratios, it is also homologous, that is the ratios must be between stresses of the same character. The method is illustrated in a simple form in Fig. 1, which shows an assumed case of two different types of loading. The stress ratio R represents the ratio of an applied simple stress, f, to the allowable or failing stress, F, for the *simple* loading condition. R_1 therefore represents one condition, R_2 another.

The interaction of the two loading conditions, or the effect of one on the other, is shown by the *interaction curve*, the shape of which will depend on the nature of the loading conditions being considered. It will be shown later that this curve can usually be expressed in the form of a *stress-ratio equation* of simple form. In any case it is possible to derive such a curve from actual test data or theory.

Once the interaction curve has been obtained, it immediately becomes possible to predict the effect of one loading condition on the other. For instance, the presence of a loading condition (1) such that $R_1 = a$, (in Fig. 1), will reduce the amount of stress which can be taken in loading condition (2) to a value corresponding to $R_2 = b$. Thus the values of R determined by the interaction curve are seen to be "factors of utilization" (a term often proposed to replace "margin of safety") which depend on each other. The presence of one loading condition usually decreases the factor or utilization" of the other to a value somewhat less than 1.0, which corresponds to the simple loading condition. (It will be shown later that in certain unusual cases the factor of utilization is *increased* above 1.0 by the presence of another loading condition.)

(Turn to page 43)

f — applied stress.
F — allowable or failing stress for simple loading conditions.
$R = f/F$ — stress ratio or factor of utilization.
$_b$ — bending.
$_c$ — compression.
$_s$ — shear.
f_b — primary bending stress.
f_b' — total bending stress (including secondary effects).
F_c — allowable compressive stress. (For columns this is determined from the basic column formula).
F_{cs} — limiting column stress (intercept of column curve for $L/\rho = 0$).

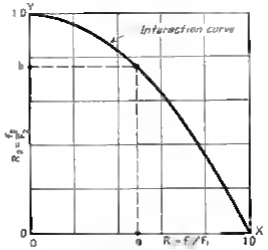


Fig. 1: Illustration of stress-ratio method for two loading conditions

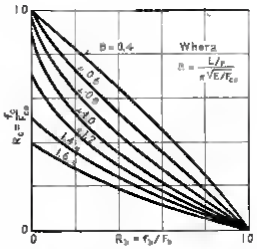


Fig. 4: Combined bending and compression of round steel tubes

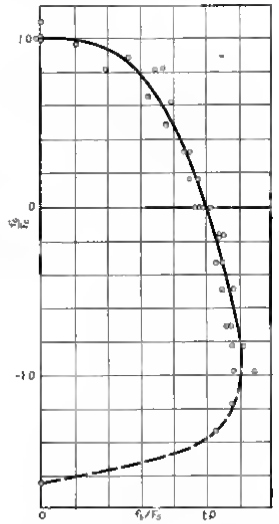


Fig. 7: Combined torsion and compression of thin-walled cylinders

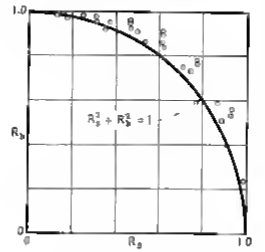


Fig. 2: Combined torsion and bending of round steel tubes

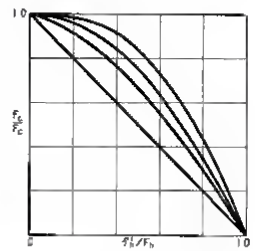


Fig. 5: Interaction curves for round tubes subjected to compression and bending

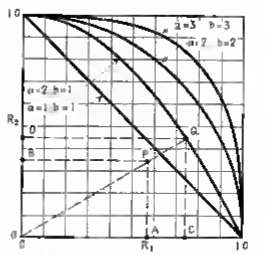


Fig. 3: Typical interaction curves

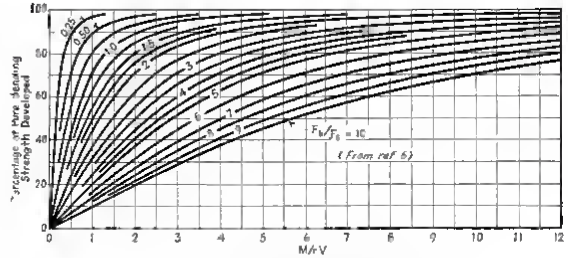
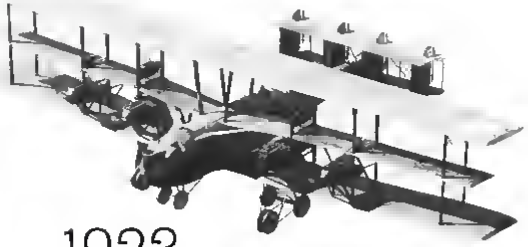


Fig. 6: Chart for bending strength of thin-walled cylinders subjected to combined transverse shear and bending

BIGGER
BOMBERS

When the wire draped box-kite was in its prime, Boeing's latest would have been thought too fantastic for serious consideration.

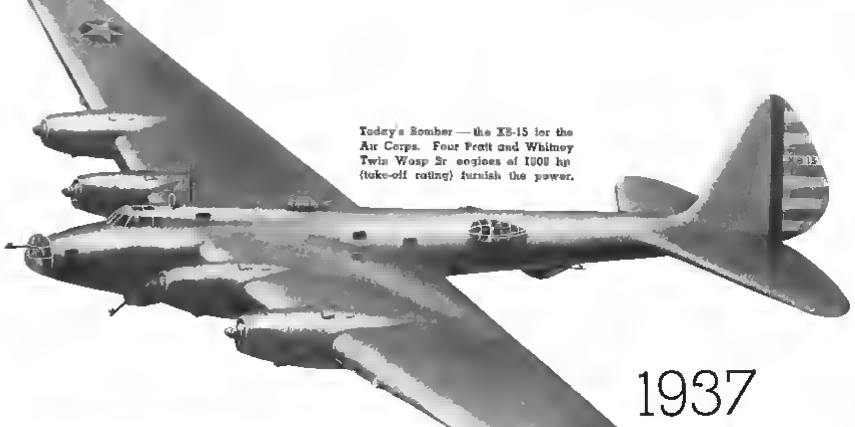
The tail wheel is tested in a special drop test jig, believed to be the largest of its kind ever built.



1923

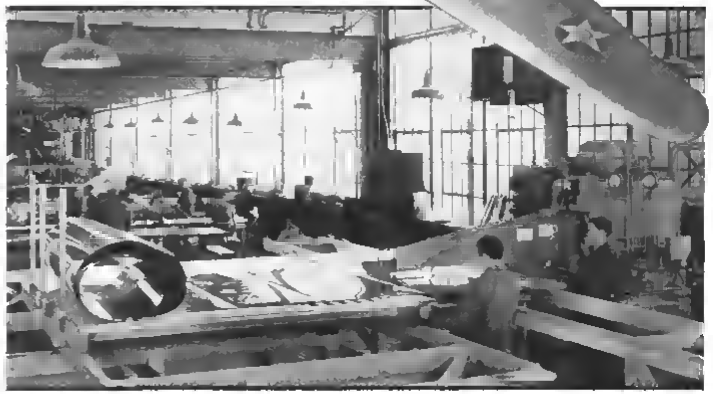
The Barling Bomber represents the Air Corps' first approach to the large bombardment airplane problem, a project which was undertaken during the period of 1920-25. With a 120-foot wingspread and six engines it had a top speed at sea level of 86 m.p.h.

A glimpse inside the hammer shop showing the shaping of circumferential stiffeners for the semi monocoque fuselage



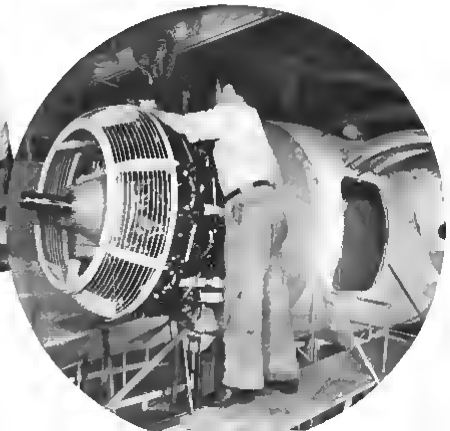
Today's Bomber — the XB-15 for the Air Corps. Four Pratt and Whitney Twin Wasp Sr engines of 1000 hp (take-off rating) furnish the power.

1937



A new electric spot-welding machine in operation on a sheet of duralumin for the bomber.

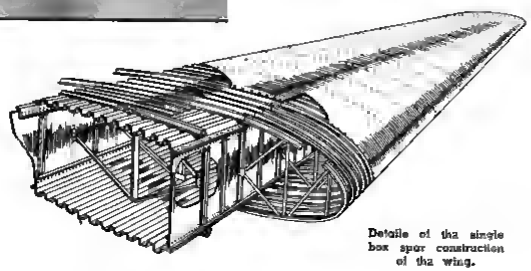
Two men inside an engine nacelle in the actualsize wooden mock-up demonstrate the operation of a hand starting crank. Right: This view of the wooden mock-up shows how mechanics will be able to emerge from a doorway in the engine nacelle onto a special platform providing ready access to the engine



British Ensign

Forty passenger, four engined landplane nears completion

Flying Equipment



Details of the single box spar construction of the wing.

DESPITE THE HANDICAP of frenzied military production Great Britain has been able to develop a large landplane destined to take a prominent part in the long range plans to revolutionize the routes of Imperial Airways. The four-engined Ensign by Armstrong Whitworth compares in size with our Douglas DC-4, having a slightly longer fuselage and a somewhat shorter wing span. Two types, differing mainly in internal arrangements, will be produced. The European class has a capacity of 40 passengers while the Empire class seats 27 or sleeps 20. Power plant in both cases consists of four medium supercharged Armstrong Siddeley Tiger IX engines developing 880 hp each at take-off and 800 hp. at 7200 ft. Calculated ceiling with three engines is 12,500 ft., with two engines, 4,000 ft. With a gross weight of more than 20 tons, the maximum speed is estimated at 200 m.p.h., and cruising speed is 160 m.p.h. Range, against a 40 mile head wind, is expected to be about 500 miles.

In these days of low wing transport standardization it is surprising that the Ensign should turn out to be a high wing monoplane. Naturally this arrangement complicates the problem of retracting the landing gear. The 7 ft. 6 in. diameter wheels must be raised through an arc of 14 ft. radius to a retracted position high up in the inboard engine nacelles. Lockheed retracting gear units are used for this purpose.

Most interesting feature of the wing construction is the single box spar built in three sections, all similar in construction. Front and rear web members are light alloy sheets having flanges formed of "Z" section members folded to shape and riveted to the sheets. Vertical stiffeners also are riveted to the web. Longitudinally corrugated sheets are bent upon a folding machine to form the upper and lower members of the box spar. Torsional rigidity is enhanced by an internal system of vertical and diagonal struts. Over the corrugated sheets, transverse stiffeners of flanged U section are laid to carry the 22 gage skin which is attached by pop rivets inserted from the outside. The transverse stiffeners provide convenient attachment for the nose ribs. The metal skin covers the leading edge and goes as far back as the rear web member of the box spar. Behind that point fabric covering is used over special light alloy sections.

The wing is provided with split trailing edge flaps from the fuselage to the ailerons. The latter are of the Frise type, mass balanced. Their structure is metal and their covering fabric. Servo flaps are operated from the cockpit.

The fuselage structure consists of a number of light transverse rings with their outer edges cut to accomodate longitudinal stringers of flanged U section. Covering consists of 22 and 24 gage sheets laid on lengthwise in so far as possible. Rivets are not countersunk. All joints are sealed with a compound known as Bostik. Simmonds self-locking stop nuts (made under license from the Elastic Stop Nut Corp.) are used extensively in the structure.

Attached to the tail of the fuselage at four points is the stabilizer unit. Construction of this unit is similar to that of the wing, but it is covered entirely with fabric. Adjustment can be made on the ground and elevator tabs are used for trimming in the air. The fin is built into the fuselage and has three important vertical structural members including the rudder post. Both vertical tail surfaces are covered with fabric. Cockpit control is provided for the trimming tab in the rudder.

Two of the four engines drive 24 volt, 1000 watt generators. Fuel tanks are two in number, each having a capacity of 325 gal. and located between the engines in the wing. Oil tanks conform in shape to the leading edge of the wing and are carried on the outside of each pair of engines. Their total capacity is 40 gal. Three bladed De Havilland controllable pitch propellers (Hamilton-Standard license) are also used in the power plant.

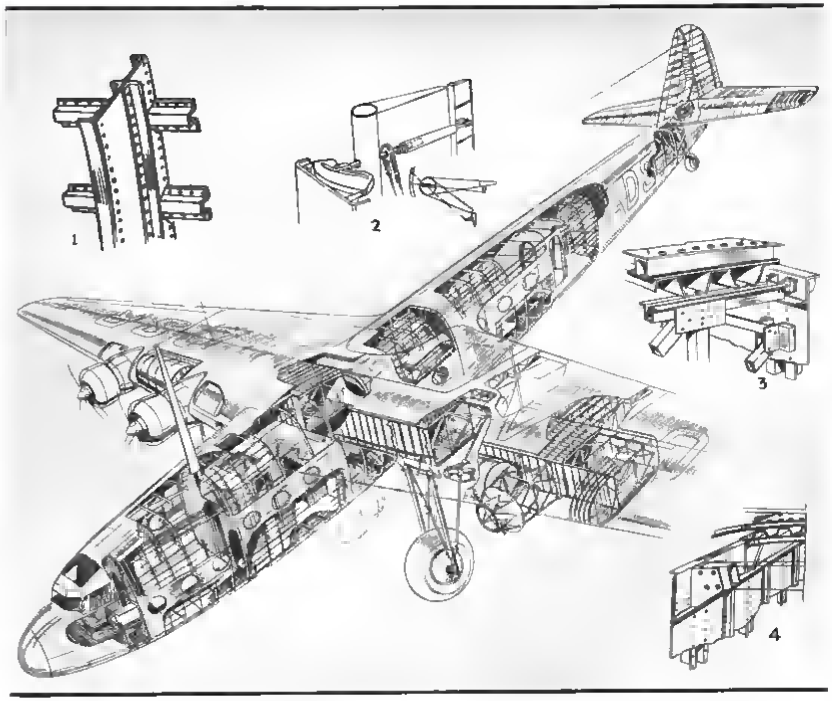
Internally, the fuselage is divided into several compartments. The control cockpit for pilot and co-pilot is in the extreme nose and behind them is the space for the radio operator and his equipment. Behind the radio compartment is a smoking room with chairs for nine passengers, or berths for four. Next is a section devoted to an upper and lower freight compartment, the former having an emergency hatch in the roof and the latter being fitted with a loading hatch in the wall of the right side. Between the freight section and the midship cabin are lavatories, galley and an office for the purser.

Nine passengers can be accomodated by day and eight by night in the midship cabin, and accomodations for nine by day or night are provided in the after cabin just behind. Separate ventilators are provided for each passenger. A patented steam heating system utilizes the exhaust heat to generate steam which in turn heats air brought into the system through vents in the nose of the ship.

The Ensign has been designed under the direction of J. Lloyd, father of the earlier Atalantas and Argosies used for so many years by Imperial Airways.

General layout and structural details of the Ensign. 1—Attachment of stringers to rings in the fuselage construction. 2—Detail of rudder tab control. 3—Construction of the tail surface box spar. 4—The box spar construction of the wing.

Sketches Courtesy "The Aeroplane"



Allison 1,000 hp. Engine

Vee type liquid cooled power plant passes Army 150 hour test.

THE DEVELOPMENT of high temperature coolants of the Ethylene Glycol type to replace water in liquid cooled engines has opened the way toward new possibilities for the use of engines of this type. For several years the Allison Engineering Division of General Motors has been working in secrecy on a 1,000 hp. vee type, chemically cooled engine for the Army Air Corps, and the 150 hour type tests required by the Air Corps were passed several weeks ago.

The Allison engine is probably the first aircraft power plant to be specifically designed for chemical cooling with Ethylene Glycol having a boiling point of 387° F. The rates of coolant flow and the temperatures at all points around the cylinders, valve seats, spark plugs, etc., were carefully determined by experiment so that very uniform cylinder and head temperatures are experienced. This makes the engine design very flexible as to adaption for fuels of higher octane ratings as well as provides for the ready adjustment of radiator requirements to meet compression ratio and altitude requirements for particular installations.

The Allison 1,710 cu. in. chemically cooled engine is a 12 cylinder 60° vee type with built-in reduction gear of 2.1 ratio and with a centrifugal supercharger which is a part of the accessory housing. The engine is made up of a cast aluminum upper and lower crankcase and two 6 cylinder blocks, each consisting of single aluminum alloy casting containing the combustion chambers and valve mechanism and into which the steel cylinder barrels are fitted. The valves, of which there are four per cylinder, are driven by an overhead camshaft completely enclosed and flooded with oil. The valve mechanism is accessible by means of a single cast magnesium alloy cover extending the length and the breadth of the cylinder head. The heat treated steel cylinder barrels, the valve seats and valve guides, are pressed and shrunk into the machined cylinder head castings. The exhaust valves and valve seats are Stellite faced.

Each of the two cylinder blocks consisting of the aluminum head, six steel barrels and a cast aluminum jacket are mounted to the upper half of the crankcase by fourteen long stud bolts extending through the head and into the case. This construction results in the power forces being transmitted to the crankcase which in turn is stiffened by the truss construction formed by its combination with the cylinder heads and barrels.

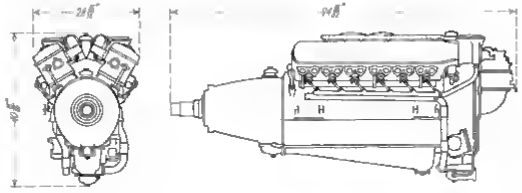
The overhead camshaft is driven by beveled gears through the medium of a long slender shaft in the upper part of the crankcase which is driven by the reduction gear at twice engine speed. This long shaft has relatively high flexibility and results in a valve actuated mechanism free from torsional disturbances.

The crankshaft is a conventional six throw type, all surfaces of which are lapped or polished. The crankshaft journals are hollow and fitted with removable aluminum alloy plugs. The counter-weights are welded to the forged shaft, providing a clean, compact design. The propeller reduction gear pinion is splined directly to the front end of the crankshaft. A spur gear is splined to the rear end of the crankshaft driving the oil pump, coolant pump, fuel pump, vacuum pump and generator. The engine starter also operates through this gear. The engine is equipped with a vibration friction damper at the front end and dynamic torsional balancer at the rear end. These devices provide for a large range of over speed without detrimental vibration.

The reduction gear consists of an internal spur gear which meshes with the pinion gear splined on the crankshaft. The internal gear is bolted to the propeller shaft by a flange which is integral with the shaft. A large single piece steel back bronze bearing completely encircles the external diameter of the internal gear.

The reduction gear together with the propeller shaft are encased in a single aluminum alloy casting which forms the nose of the engine. This in turn pilots into and is stud fastened to the upper and lower crankcase.

Flying Equipment



The propeller shaft assembly located in the reduction gear housing consists of two hollow tubular shafts which are concentric with each other. The inner shaft transmits the power torque of the engine while the other shaft takes care of the bending loads produced by the propeller.

The pistons are machined from aluminum alloy forgings and the underside of the piston heads are grid-ribbed to facilitate cooling. The connecting rods are of the forked and blade type machined and polished all over. Two rods are mounted on each crankpin with a single split steel back bearing faced with lead bronze inside for crankpin bearing and outside for the blade rod bearing.

The accessory housing is mounted directly on the rear of the crankcase and is a magnesium alloy casting and contains the centrifugal supercharger and the drives for the coolant pump and camshafts, fuel pump, vacuum pump, oil pump and generator. The supercharger impeller is 9½ in. in diameter and is driven at 6.75 times the crankshaft speed. High supercharger efficiency is obtained by six curved vanes in the diffuser passage. The supercharger impeller shaft is supported on two steel back lead bronze floating bearings which results in unusually trouble-free supercharger operation in spite of the high speed involved. The supercharger, like the camshaft, is driven from the reduction gear by the long flexible shaft and obviates the necessity of clutches usually required to take care of the effects of rapid changes of speed of the crankshaft.

A single Bendix Stromberg four-barrel downdraft carburetor with automatic mixture control mounted on the rear of the accessory housing supplies the fuel-air mixture to the supercharger which delivers the mixture to the ramming type manifolds. The manifolds contain grids to prevent back-fire flames from reaching the supercharger.

Ignition is supplied by one fixed timing high tension Scintilla double magneto. The current of the magneto is distributed to the spark plugs through two separate camshaft driven high tension distributors. Two spark plugs are used for each cylinder. When the engine is enclosed in a tight cowl, a blast of cooling air for the exhaust plugs is supplied by a light aluminum alloy manifold.

The vee type chemically cooled engine has distinct advantages for the installation of an exhaust driven turbo supercharger which can be located immediately under or to either side of the engine with a short exhaust line and short air pressure lines to the intercoolers and the carburetor. Chemical cooling also permits locating radiator equipment where drag is at a minimum.

Specifications

Bore 5.5, stroke 6.0". Displacement 1710 cubic inches, overall length 94.47", overall height 80.94", overall width 28.94". Geared, chemical-cooled normal and take off rating 1,000 horsepower at 2,600 r.p.m. on 87 octane commercial fuel. Compression ratio 6.0:1, blower ratio 6.75:1, propeller shaft ratio 2:1. Weight with magneto, carburetor, coolant pump and pipes, exhaust stack flanges, tachometer, fuel pump, vacuum pump and generator drives and provision for hydro or electric controllable pitch propeller and governor—1 280 lb. or 1.28 lb. per horsepower.

Menascos Abroad—

In biplane built by Focke-Wulf for export trade

THE POPULARITY OF AMERICAN EQUIPMENT in foreign markets is evidenced by the adoption of the Menasco model C4S supercharged four cylinder inverted in line aircraft engine by the Focke-Wulf Aircraft Co., of Germany, for use in their light training biplane as built for export. It is understood that this plane, with the American engine, is popular in South American markets.

Known as the FW-44J, the Focke-Wulf trainer is a two place open biplane of rather conventional design and of mixed construction, fabric covered throughout. No performance data are available at this time, but the plane is relatively clean aerodynamically and is considered to have excellent performance when powered with the supercharged Menasco engine.

Cessna C-37

New ship being used extensively for aerial photography.

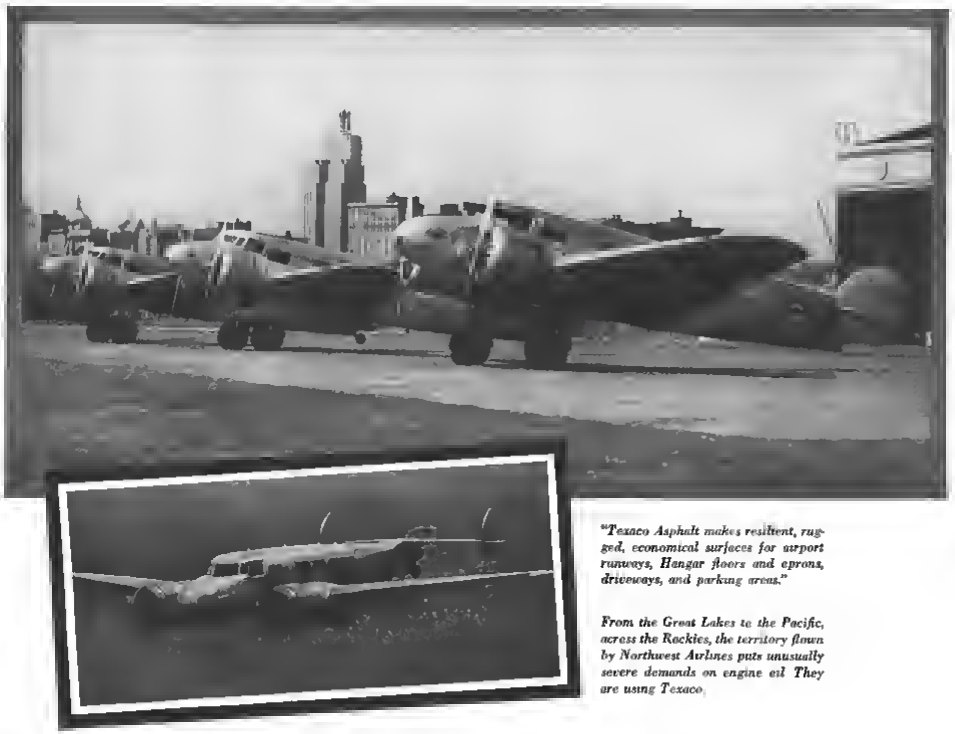
RETAINING all of the well known Cessna features, the new Model C-37 Cessna is a bigger and faster airplane than the famous C-34 which it supplants. Cabin space has been greatly increased, with larger and more comfortable seats, greater leg and shoulder room, and better vision and ventilation. Other features of the new model include carburetor temperature control from the instrument panel, improved type exhaust manifold, more efficient controls including electrically operated wing flaps, individual fuel tank gauges, longitudinal trimming tabs, more resilient landing gear, improved engine cowling, higher air speed and greater ground maneuverability. The flight characteristics of the new ship fit it admirably for aerial photography.

Powered with the new series 50 Warner Super-Scarab engine of 145 hp. the C-37 has a top speed at sea level of 162 m.p.h., cruising speed of 143 m.p.h. and landing speed with flaps of 47 m.p.h. according to the factory. Standard equipment includes dual controls including brakes, combination parking brake and rudder lock, electrically operated flaps, starter, wind driven generator, Grimes navigation lights and Kollsman instruments.

Latest in Cessnas—the Model C-37

WINGS
★ WEST OF CHICAGO

This mural in its St. Paul terminal contrasts the pioneer's trek westward with the precision flights of Northwest Airliners. Northwest, now in its 11th year, uses Texaco Airplane Oil exclusively.



"Texaco Asphalt makes resilient, rugged, economical surfaces for airport runways, Hangar floors and aprons, driveways, and parking areas."

From the Great Lakes to the Pacific, across the Rockies, the territory flown by Northwest Airlines puts unusually severe demands on engine oil. They are using Texaco.

ONE hundred and forty-two years ago, Lewis and Clark required a year and a half to push through to the Pacific. Today, Northwest Airliners cover these 2000 miles in a little more than 12 hours.

While, technically, this is probably the toughest air route in all America, Northwest Airlines has made it pleasant to travel. Everything is done for comfort and safety . . . the finest equipment . . . in all engines, Texaco Airplane Oil.

Texaco Airplane Oils resist break-down, even when thermometers in the "bad lands" of North Dakota register 110 in the shade on summer afternoons.

Using Texaco, you get longer periods of service between drains, more flying hours between overhauls.

Trained aviation engineers are available for consultation on the selection and application of Texaco Aviation Products. Prompt deliveries assured through 2020 warehouse plants throughout the United States. The Texas Company, 135 East 42nd Street, New York City.

TEXACO

TEXACO *Aviation Products*

With Foreign Builders

New flying equipment from overseas

SOME SECRECY surrounds the new Bristol Blenheim medium bomber, publicized in England as "the fastest machine of its type in the world." It is said to resemble the Bristol monoplane Britain First and the companion type, Model 143, especially the former, so strikingly that details of construction and performance are being kept confidential on the entire trio. It is known, however, that the medium bomber is a mid-wing monoplane carrying a crew of three—the pilot and navigator in the nose, radio operator-gunner in the rear of the cabin. Mercury VIII engines power this fighting craft which has the following specifications: Span 56 ft. 4 in.; length 39 ft. 9 in.; height 9 ft. 10 in.; maximum fuselage depth 5 ft. 6 in.; maximum fuselage width 4 ft. 4 in.; diameter of propellers 10 ft. 6 in.

The excellence of performance is intimated by the fact that the bomber's prototype Britain First was constructed when Lord Rothermere decided to show what an ultra-modern British plane can do. The results of the demonstration had prompted the Air Ministry to order the evolution of a medium bomber designed along similar lines, and it is now in big-scale production at Filton. Britain First or Type 142 had made its debut as a six-passenger low-wing cantilever monoplane carrying two radial engines. The third member of the Bristol family was Type 143 designed for economical commercial operations, but its production has been indefinitely

Current French bomber trends as exhibited in the latest Amiot

dropped due to the overwhelming quantity of military manufacturing at Filton. After some experimentation with such power plants as two Bristol Aquila sleeve-valve engines and the more powerful Mercury VIs rated at 605 hp at 12,500 ft., the manufacturers settled on the Mercury VIIIs. Each of these delivers 825 hp at 13,000 ft., with a maximum of 840 hp at 14,000 ft.

AN INTERESTING Chechoslovakian low-wing cantilever monoplane has invaded the British market this spring. This tandem two-seater known as the Zlin XII embodies a 45 hp. Persy II engine which is of the flat-four type, resembling externally the Continental model popular in England. Significant data include: Span 32 8 ft.; length 25 6 ft.; weight in flight 1,058 lb.; disposable load, 421 lb.; maximum speed 96 m.p.h.; cruising speed 84 m.p.h., landing speed 37 m.p.h.; climb to 1,214 ft. in three minutes; range 280 miles.

The Zlin XII has a two-spar plywood-trimmed wing, sharply tapering in plan, also a plywood-lined fuselage. Ordinarily piloted from the rear seat, it nevertheless has dual controls. The front seat has better visibility. The hinged covers of both cockpits display large sliding panels which when opened at appropriate seasons help in rendering the plane comfortably cool. The seats in these transparent-covered cockpits are equipped to accommodate back-type parachutes. The Zlin XII was originally designed to specifications prepared by the well-known Chechoslovakian shoe manufacturer Bata himself.

ITALY'S Industrie Meccaniche e Aeronautiche Meridionali has brought out the long-range reconnaissance Ro. 37 and Ro. 37-bis, two-seater biplanes. Their rounded-tip wings are mounted in the shape of a rectangle, have duralumin longerons, wooden ribs. Two tandem struts, stagger-braced, are on each side. There are two double drag-wires, one suspension wire. The upper wing's center section is joined to the fuselage with six struts and four wires. The ailerons are to be found only in the upper wing.

With side walls of treated fabric and duralumin sheet in the upper part, the Ro. 37 or Ro. 37-bis fuselage is of steel-tube. The two seats are tandem-arranged. There are dual controls, an airscope and breathing apparatus in each plane.

Two rigidly mounted machine-guns fire through the three-blade airscrew disc, one swivelling machine-gun is in the observer's cockpit. In the fuselage underside are twelve bombs, each weighing 12 or 15 kg. (26.45 or 33.06 lb.).

Semi-cantilever and braced, the empennage is of steel tube structure, with fabric covering. Control surfaces are balanced, the stabilizer regulated. The split axle type tripod undercarriage is equipped with oleo-pneumatic shock absorbers and is retractable and endowed with pneumatic brakes.

Either the Fiat A. 30 RA liquid-cooled 12-cylinder or Piaggio P. 1X RC 40 9-cylinder radial engine is used in the Ro. 37 and Ro. 37-bis, developing 560 HP at 4,000 m. (13,123 ft.). The fuel tanks are in the fuselage and center section of the wing.

Other data on Ro. 37 and Ro. 37-bis: Span 36 ft. (11.1m.), length 29 5 ft. (8.6m.), height 9.84 ft. (3m.), wing area 37 sq. ft. (31.4 sq. m.); weight empty 3,011 lb. (1,505 kg), normal weight in flight 4,680 lb. (2,340 kg); maximum speed at 9,842 ft. (3,000 m.) 201 m.p.h. (325 km/h), landing speed 62 m.p.h. (100 km/h), rate of climb to 6,562 ft. (2,000 m.) 3 min. 30 sec., to 13,124 ft. (4,000 m.) 8 mm. 45 sec., to 19,686 ft. (6,000 m.) 16 min. 30 sec. Cruising range 1,025 miles (1,650 km).

Authenticated News

LATEST IN BRITISH LIGHT BOMBERS—
the Hawker monoplane with Rolls Royce Merlin engine.

Russia's "flying flea"—the 24 hp. Octiobrenok

Soviet transport—nose of the ANT-35

NEW IMPROVED AIRCRAFT will be operated on the new Soviet airlines, which are being added this year to the extent of 2,500 kilometers, and on the older routes. The two dominant types will be the 10-seater ANT-35 and the 12-seater ZIG-1. In creating the ANT-35 in accordance with the designs of Professor A. N. Tupoleff, the Central Aero-Hydrodynamic Institute sought to enrich Soviet aviation with a speedy passenger job. Its success was fittingly proven on September 15, 1936, when with Hero of the Soviet Union Gromoff at the controls and a crew and passengers numbering seven, the ANT 35 made the round trip between Moscow and Leningrad in the record time of 3 hours 38 minutes for 787 miles. According to the Pravda correspondent aboard, it was not necessary to interrupt the trip briefly by a rest and dinner in Leningrad because the flight was so smooth that most of the time the passengers were dozing off in their comfortable arm-chairs. Special sound-proofing makes possible conversation in the cabin without raising one's voice. There is a window at each chair, the cabin is heated and an individual ventilation system is provided for each passenger. A "lunch-counter" and toilet room are toward the stern.

Replacing the more antiquated and less comfortable passenger types, the ANT-35 has roomy accommodations with a gangway down the center of the cabin. Two Russian radial air-cooled M-85 engines are rated at 850 hp. each, giving the machine a maximum speed of 268 m.p.h. The engines are in long-chord cowlings, incorporating controllable flaps on the trailing edges in the latest fashion. The propellers are three-bladers of adjustable pitch. In regard to safety, it is pointed out that of material significance is the fact that with a maximum load the ANT-35 is capable of continuing in the air with one engine, in the event of the other one's failure.

The ANT-35's gross weight is 14,500 lb.; wing span 68 ft. 3 in.; wing area 625 sq. ft. Light-and-sound signals inform the pilot whether the retractable undercarriage is in or out. A large fuel supply distributed in four tanks enables this ship to fly without landing for more than 1,243 miles. It is provided with dual controls, instruments for night and blind flying under any meteorological conditions, and an automatic pilot.

IN CONSTRUCTING ZIG-1, we learn from Chief Engineer P. Vinkoff, of the Holtzman Plant, the aim was "to create a machine which would correspond to the demands of modern passenger aircraft. This means above all else good speed, an adequate flight range without a stop, safety and comfort for passengers. ZIG-1 answers these demands." It is a low-wing all-

metal (koltchug-aluminum) plane. The spacious cabin provides comfortable accommodations for 12 passengers and two pilots. There are also baggage compartments, a toilet room, buffet and a clothing closet. Cabin furnishings received special attention, with the result that there are soft chairs with adjustable backs, individual ventilation and lighting.

Two Soviet M-17 engines of 500 hp each are mounted in the ZIG-1; in the event of one's failure, the plane may readily proceed on the remaining engine. According to preliminary calculations the ZIG-1 was to have a maximum speed of 205-05 miles an hour and cruising speed of 171-174 m.p.h. Thanks to controllable flaps and brake-wheels, the landing speed is not to exceed 56 m.p.h. Up-to-the-minute equipment and instruments for blind flying and night landings are at the disposal of the pilot.

WHILE IN ENGLAND and other Western European countries there has been discernible of late a certain amount of disillusionment with the "flying flea" type, the U.S.S.R. is reporting excellent results with the tests of the "Octiabrenok" machine called an air motorcycle by Russians. Designed by Engineer P. D. Grushin, the "Octiabrenok" has a span of 19 ft 6 in., length of 16.4 ft, and a 24 hp. engine, and has good maneuverability with the engine either on or off. On its test flight Pilot Zhukoff took it to the altitude of 3,300 feet in 12 minutes and stunted it. On other test flights it attained 84 m.p.h. It is said that with the substitution of a more economical engine it will fly non-stop for at least 621 miles. Designer Grushin asserts that it is superior to foreign-made aerial fleas because it cannot go into a nose dive or spin, even when the pilot makes a special effort for that purpose.

—*LUCIEN ZACHAROFF*

Stress Ratios

(*Continued from page 29*)

A practical case will illustrate the simplicity of the method. Test data for round steel tubes under combined bending and torsion (from Ref. 3) have been reduced to stress-ratio form and plotted in Fig. 2. A single curve, which happens in this case to be the arc of a circle, conservatively represents the empirical "interaction curve." The corresponding equation would be

$$R_s^2 + R_b^2 = 1 \quad \ldots\ldots\ldots\ldots (1)$$

In this case R_s represents the fraction of the allowable pure shear stress utilized and R_b the fraction of allowable pure bending stress. In running a stress analysis it is only necessary to show that the numerical value of the left side of the equation is less than 1.0. The method of obtaining a "linear" margin of safety will be discussed later.

General Significance

Before taking up particular cases of combined loadings it may be of some interest to examine the method more closely and to indicate its general significance. The equation which was given for the illustrative case in the preceding discussion can be generalized into a very useful form which, for cases involving only two types of loading, is as follows:

$$R_s^a + R_b^b = 1 \quad \ldots\ldots\ldots\ldots (2)$$

The effects of varying the exponents a and b can be seen from Fig. 3. It is obvious that when a and b are each equal to 1 we have a straight line for the interaction curve. Making one exponent equal to two yields a parabola. With each exponent equal to 2 we get a circular arc. As we increase the exponents the curves approach the boundaries given by $R_s = 1$ and $R_b = 1$. With infinite exponents we should therefore attain complete independence, or zero interaction. This suggests that the basic equation should have the form

$$R_s^{\frac{1}{a}} + R_b^{\frac{1}{b}} = 1 \quad \ldots\ldots\ldots\ldots (3)$$

in which the value of the terms a and b would denote the degree of interaction. Although attractive in form, this equation is not as simple as Eq. 2, which will be preferred for engineering purposes and will therefore be used in the following discussion.

Apply Common Sense

An interesting advantage of the stress-ratio method is its adaptability to intuitive reasoning and common sense, which is important in all engineering problems. It is reasonable, for instance, to assume that two loading conditions of very similar nature would give a straight line interaction curve, indicating direct addition of the effects. On the other hand, conditions in which the critical stresses or forces are not acting at the same angle or at the same point could be expected to have a lesser degree of interaction.

The case of combined bending and torsion is of this type. In a thin-walled tube the failure is produced by normal compressive stresses (not shearing stresses) resulting from the combination of the stresses due to bending and torsion. Since we know that the normal stresses due to torsion act at an angle of 45 deg. from those due to bending it is not surprising to find that the interaction curve is a circle, denoting less interaction than the straight line which we assumed would hold for stresses of the same nature. (Those acquainted with vector analysis will interpret the circle simply as the result of considering the straight line equation to be a vector equation, the vectors acting normal to each other. This parallels the loading condition, in which bending and shear loads act normal to each other.)

The engineer can often supplement a few test data by plain reasoning to obtain a conservative interaction curve, based on his knowledge of the relative "viciousness" of the loading conditions involved. An important point in this connection is the fact that the end points of the interaction curve are always correct, at least they accurately represent our knowledge of failure under simple loading conditions. This greatly reduces the probable error involved when one type of loading predominates. A further advantage of stress ratios, which hardly needs to be mentioned, is that a single interaction curve will often be found to hold for different mechanical properties and even for different materials. This feature is particularly useful in dealing with heat-treated materials.

Margin of Safety

It is possible to obtain what is known as a linear margin of safety directly from the interaction curve. This method, which was first introduced in the 1933 edition of Aeronautics Bulletin No. 7-A by one of the authors, and which now appears in Aero Bulletin No. 26, is illustrated in Fig. 3.

Assuming that the applied values of R_s and R_b are known and are given by A and B, a point, P, can be located on the diagram, as indicated. A line drawn through this point and the origin, O, is extended to intersect the interaction curve at Q, giving corresponding values of R_s and R_b equal to C and D, respectively. The "factor of utilization" is obtained from the ratio of B to D or A to C, both ratios

(*Turn to page 66*)

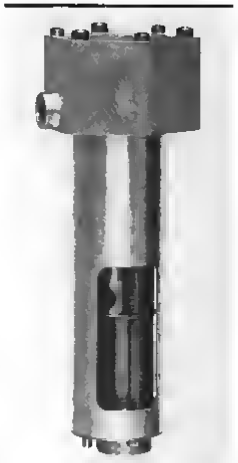
Buyers' Log Book

What's New in Accessories, Materials, Supplies, and Equipment

Cuno Oil Filter—

Automatic self cleaning type announced by Cuno Engineering

RECENTLY INTRODUCED by The Cuno Engineering Corporation, Meriden, Conn., a new model aircraft engine oil filter features automatic self cleaning. Using the well known Auto-Klean principle, this new unit incorporates a compact, self-contained oil operated mechanism which cleans the filtering element continuously while the engine is in operation. Oil to be filtered is introduced in the space surrounding the filtering element, a stack of wheel shaped discs spaced only 0.0035 in. apart, and passes between the disc rims to the central passages leading to the filter outlet. Solids, lint, gummy and other foreign substances are retained by the disc edges and a series of cleaner blades so mounted as to comb clean each individual filter slot when the cartridge is rotated, carries away all accumulations on the filter surfaces. Power to drive this combing unit is obtained from the engine oil itself, depending on the difference in oil pressure between discharge and suction sides of the lubricating oil pump. The new automatic self-cleaning filter was developed in conjunction with the Wright Aeronautical Corporation.—AVIATION, *June, 1937*.



Cuno oil filter. An engine oil filter that is self cleaning.—Cuno Engineering's latest.

DeVilbiss Pump—

Type QB pump circulates non pigmented finishing materials from container to spray gun

FIRST EQUIPMENT OF ITS KIND to be offered, a new fluid circulating pump, Type QB, for delivering clear varnish, lacquers, dopes, and other non pigmented materials direct from the shipping container to the spray gun has been developed by the DeVilbiss Company of Toledo, Ohio. Operation of the unit is by electricity or air motor. Mounted directly on the shipping container, the unit pumps the fluid directly through the spray gun, saving time and producing a high quality of work due to the even pressure maintained on the spray gun.—AVIATION, *June, 1937*.

DeVilbiss type QB pump for handling dopes and varnishes.

Concealed Chute

New Switlik parachute completely enclosed in chair upholstery.

INCORPORATING all the features of the standard Switlik Safety Chute, the new Switlik Chair Chute at the same time provides complete concealment of the harness. The chute is so upholstered as to harmoniously match the cabin interior of the plane in which it is used and there is no evidence of the presence of a parachute other than the connector snap and "D" ring protruding from opposite sides of the chair back upholstery and the seat cushion. A tug at the hardware by the seated passenger pulls the shoulder straps quickly out into position and the harness is quickly adjusted to compensate for size of the individual by a simple sliding adapter arrangement connecting the left webs. The lap strap is as easily adjusted for size and on arising the passenger finds that the parachute pack lifts out of the chair back easily.—AVIATION, *June, 1937*.

Low Price Radio

Two-way unit by Lear has crystal control

AIMED AT THE PRIVATE PLANE FIELD, the newest two-way Learadio T30–R3 equipment should prove of wide interest for its combination of unusually low price and wide range of desirable features. A crystal controlled, 100 per cent modulated set of 300 watts output, the new Learadio provides multi-frequency transmission with choice of telephone or telegraph. Although ruggedly built, the size of the equipment is quite small, and the weight complete only 24 lb. A number of accessory units are available for specialized installations, such as the Learadio motoreel, remote control unit, and special antenna for seaplane use.—AVIATION, *June, 1937*.

Operators' Corner

An exchange of ideas on the problems of the commercial aviation industry

QUESTION 22: To what extent does the family of a prospect for instruction or airplane purchase influence the sale? How do you sell the family? Do you invite his wife for a demonstration or do you evade the issue entirely? If you see fit to bring her into the negotiations, at what point in the selling process is it most effective? What ideas have you found most effective in "selling the lady?"

Sell the Whole Family

WE HAVE FOUND FROM EXPERIENCE that all members of a family, especially a wife or husband must be agreeable to the proposition. To sell the whole family requires one or more flights of a very conservative nature. It is largely a matter of education and every family is different. Most wives have the idea that when the subject is first mentioned by her husband that he is trying to invent a new method of suicide. This may be a bit exaggerated but the one big idea that must be sold to her is that flying is safe. This can usually be done if the woman is at all reasonable and open-minded. However, we have lost many a student and sale of an airplane because of our lack of ability to convince the wife that her husband won't kill himself if he takes up flying.—A. ELLIOTT MERRILL, *Pres., Washington Aircraft & Transport Corp., Boeing Field, Seattle, Wash.*

Please the Women

THE FAMILY OF A PROSPECT for airplane sales sometimes influences the sale greatly. The best possible method we have found to sell the family is through education as to the real facts about flying. We always go the limit to please the woman in the case because she frequently has the last word regarding the sale. Where and when we bring her into the negotiations depends entirely on the individual case. It must be determined on the basis of experience. There are many ideas that can be introduced to "sell the lady" on the advantages of flying. Chief among these are an appeal to the natural desire to travel. Certain types of prospects' wives react favorably to sales arguments pointing out the prestige attached to airplane ownership. Others are happier in the realization that an airplane broadens one's horizon. In final analysis it depends on how successful you are in sizing up your prospect and those members of his family you must sell along with him.—*The H. C. Robbins Company, Waco Sales, Cleveland Municipal Airport, Cleveland, Ohio*

QUESTION 23: What solution have you found for smoothing out week-end and holiday peaks in the use of equipment? Do you maintain enough airplanes for slow day requirements and rent equipment from other operators when needed, or do you find it more profitable to have ships idle during the week?

Appointment Control Helps

THE PROBLEM OF SMOOTHING OUT THE PEAK in flying school business on week-ends and holidays is always a difficult one and it is particularly acute in a school such as the one we operate because of the large number of students who must study flying in their leisure time outside of working hours.

First of all we encourage students to come out on week days even if they have to get up very early in the morning before business hours. In this we are fairly successful but the fundamental weakness in the arrangement is that if a student is enthusiastic enough to rise at 6 A.M. to get in flying time, he usually wants to come around on every possible holiday, Saturday, Sunday and in fact at every opportunity when his purse permits.

We have developed an appointment sheet form (See AVIATION, *May*, 1937, page 27) which we have found very helpful in keeping our dates straight during rush periods. The sheet consists of a ruled form with vertical columns for each of our regular ships and with provision for two relief ships and horizontal columns for each 15 minute period from 7 A.M. to 7 P.M. The last fifteen minutes of each hour is held open in making advance appointments and is used for emergencies, such as students who turn up without appointments or extra long flying periods. This leaway, plus that afforded by relief ships, has done much to help us smooth out our traffic peaks.

It is sometimes necessary to hire relief ships when needed from local operators on our airport.—RICHARD SPENCER, *Founder, The American Escadrille, Floyd Bennett Airport, Brooklyn, N. Y.*

Discount for Early Flying

WE HAVEN'T FOUND a satisfactory solution to take care of rush business on week ends and holidays. We did find a plan that helped keep the planes busy in the mornings of Sundays and holidays which relieved the afternoon and evening flying. We offered a 10 per cent discount on flying done before ten o'clock in the morning. This brought some pilots and students out earlier than usual and enabled us to do additional flying the rest of the day.—*A. Elliott Merrill, President, Washington Aircraft & Transport Corp., Boeing Field, Seattle, Wash.*

Don't Have Idle Ships

IN OUR BUSINESS which is largely special charter service our Sundays and holidays are generally the same. The high depreciation costs would make it too expensive to maintain equipment for special extra short time business.—*The H. C. Robbins Company, Waco Sales, Cleveland Municipal Airport, Cleveland, Ohio.*

Next Month's Question

QUESTION 24: What methods do you use to give your students cross-country flying experience and at the same time make their flying attractive to them? Do you stage air meets, group flights, etc.? If so, how often and how far from the home port do you go? How do you guard against mishaps in these flights and contests? Have you found such activities worth while?

News of the Month

Highlighting recent events in the aviation world

Bureau Reorganizes—

Howard F. Rough named Assistant Director. Seven major divisions set up. E. B. Cole named Technical Assistant

FINAL REORGANIZATION of the Bureau of Air Commerce, more or less disorganized since Eugene Vidal resigned the directorship on March 1 and Fred Fagg was appointed to succeed him, was announced late in April.

Bureau reorganization had been expected for some time, after the Copeland Air Safety Committee had severely criticized the old set-up.

To succeed Maj R. W. Schroeder (resigned to go with United Air Lines as operations manager) as Assistant Director, Commerce Secretary Roper appointed Howard F. Rough, territorial manager of the Aviation Division of the Gulf Refining Company. Mr. Rough is a Bureau man of old. He joined the Bureau (then Aeronautics Branch of the Department of Commerce) in 1928, and in 1929 was made Assistant Chief of the Inspection Service. In 1931 he was transferred to the Detroit inspection district, as supervising aeronautical inspector.

The next day, April 29, Assistant Secretary Johnson gave details of the new setup under which the Bureau will function. Under the Director and Assistant Director, to whom E. B. Cole, Secretary of the Illinois Aeronautics Commission, will act as Technical Assistant, the Bureau will consist of seven divisions, each with its own chief. The first is Airways Engineering, to be headed by Charles I. Stanton, for many years chief engineer in the Air Navigation Division. This division will embrace sections on construction and maintenance, with their respective functions kept quite distinct. No. 2, Airways Operation, will be headed by Earl F. Ward, who organized the Bureau's Airways Traffic Control system. This Division will deal with all airways operations, including traffic control and radio communication.

The Safety and Planning Division, for which no chief has yet been named, will carry on all the development and promotional work for the Bureau, including studies to be made for all other Bureau divisions. The airport section will be included in this research program.

The service agency for the Bureau, the Administrative Division, will be in charge of John S. Collins.

The Information and Statistics Division, headed by Frederick R. Neely since about 1930, is at present without a chief, as Neely resigned on May 22 to join the aviation department of Gulf Oil, as assistant to Maj. Al Williams.

Bryan M. Jacobs, Chief of the Airline Inspection Service after Maj. Schroeder was named Assistant Director of the Bureau, will head the new Certificate and Inspection Division. This Division includes five sections heretofore grouped with the regulatory activities of the Bureau, and two new ones, Airline Inspection Service (Interstate) and Airline Inspection Service (International), under J. B. Jaynes and E. L. Yuravich, respectively.

Chiefs of the other sections of Certificate and Inspection will be L. V. Kerber, Aircraft Airworthiness; R. S. Boutelle, General Inspection Service; Dr. R. F. Whitehead, Medical; Harry Agerter, Airways Inspection Service, and Ward Davis, Link Trainer Service.

The seventh Division under the reorganization will be Regulations and Enforcement, headed by Denis Mulligan.

To deal with all matters affecting policy within the Bureau, a Policy Board consisting of the Director, Assistant Director, and heads of the seven divisions, with the Technical Assistant as Secretary, will be established.

Atlantic Record Broken—

Merrill and Lambie set five day New York-London round trip mark, fly 24 hrs. blind on westward crossing

COMPLETING THE FASTEST ROUND-TRIP ATLANTIC CROSSING ever made by any means of transport, Henry T. (Dick) Merrill and John S. Lambie set their Lockheed Electra down on Floyd Bennett Field, New York, April 14, after a 24 hr. 22 min. 25 sec. flight from Southport, England. Just 35 sec. under five days earlier, they had lifted off the runway at Floyd Bennett for the eastward crossing.

The flight was a successful commercial venture, its principal purpose to bring back pictures of King George's coronation for the ever-hungry American press. One of its most significant aspects, time playing the important role it did, was that it was made with almost no regard for weather. On the return trip the fliers had a 24-hr. stretch of blind flying, relying almost entirely on their Sperry Gyropilot and RCA Radio Compass. The Pratt & Whitney Wasp engines, according to Merrill, functioned perfectly, as did the Hamilton Standard constant speed propellers.

Only mechanical failure was a gasoline gage, which, indicating a dangerously low fuel supply, brought the fliers down at Squantum, Mass., for a 22 minute stay. There they found they still had 170 of the original 1,325 gal.—about four hours—and continued on to New York.

Radio communication equipment consisted of a Western Electric Type 13-C 50 watt transmitter, modified for use of three frequencies, and a Western Electric Type 12-D receiver. The transmitter, which operates on both voice and telegraph, was used for direct radio telephone communication with Newark Airport for the first 900 miles, and for radio telegraph until Merrill and Lambie were only 100 miles off the Irish coast.

In charge of technical arrangements for the flight was Albert I. Lodwick, of the Curtiss-Wright Corp., long-standing friend of Dick Merrill. Financial backing came from Ben Smith, a New York broker who was indulging an aviation hobby. He purchased Merrill's Lockheed, the Daily Express, from Harold S. Vanderbilt for a reported $55,000. It was a standard Electra, powered with 550 hp. Wasps, and was, incidentally, the 65th Electra to be placed in service and the seventh Lockheed to make an Atlantic crossing.

Ocean Progress—

Western terminals settled, PAA prepares for Bermuda flights

START OF PRELIMINARY ATLANTIC FLYING seemed definitely in the offing by early May, with experimental flights by Pan American on the Bermuda - New York leg scheduled for late in that month. One of PAA's Sikorsky S-42B boats was being fitted out at Bridgeport for this work.

The terminal difficulties on this side of the ocean seem well settled. New York, long doubtful whether it would have a part in the venture, breathed easier April 21 the city's Sinking Fund Commission voted favorably on a huge project for the improvement of the city's Municipal Airport No. 2, at North Beach in Queens. Long idle, except for fixed base operations, and long urged as an ideal site within the metropolitan area for a major air terminal, North Beach has ample facilities for both land and water craft, is within 15 or 20 minutes of mid-town New York.

Ultimately, the improvement project will cost up to $8,000,000, and will provide extension of land facilities and dredging for flying boat operations.

Also to be used as terminals will be Baltimore, where a vast improvement program is under way, and Charleston. All three points along the seaboard will have their share of traffic, choice of port depending largely on weather.

Diplomatic difficulties were finally settled April 20, when representatives of Great Britain, Canada and the Irish Free State met in the office of Commerce Secretary Daniel C. Roper, and presented Pan American with non-exclusive permits for operating in and out of terminals situated in their respective countries. (See page 19) Following this award some criticism was voiced, suggesting that Pan American Airways was being given monopolistic preference among American companies for operation of the service. To this Secretary Roper replied that "any American air transport company might have and still may apply for landing rights . . . and receive the same United States' approval already given." In the matter of mail contracts, the secretary said that they would be let after inviting bids, "according to Post Office Department statements."

In the matter of Atlantic routes, Pan American has several in mind, none is definitely selected as yet, because Atlantic flying experience has been too limited. Planes may start from any one of the three American terminals (New York, Baltimore, Charleston), and a number of combinations of legs are possible there after. The three most likely, assuming a start from New York, would be New York - Bermuda - Azores - Lisbon - London, for a total of 4,865 miles. The Northern route would run from New York to Shediac, N. B. to Botwood, the great new base being constructed in Newfoundland by Great Britain, to Foynes, at the mouth of the River Shannon in Ireland, then to Southampton, the temporary British flying boat base. Total mileage this way would be 3,417. These two are the principal ones being considered. Other possibilities are via St. Johns, Newfoundland, then to the Azores, and on to London via Lisbon. This St. Johns-Azores over-water flight is only 1,359 miles. Also possible is a far Northern route by way of Labrador, Greenland, Iceland, Copenhagen.

Douglas DFs Go to Far East

RECENT DOUGLAS SHIPMENTS have included two of the new 32 passenger twin engine DF flying boats, one each going to Russia and Japan Air Transport, the second of such planes for each customer. Japan Air Transport is understood to be placing the Douglas boats on the Japan-Formosa run.

More West Coast Plants

IN ADDITION to expansion of existing aviation factories the Southern California aviation industry reports substantial new plants established. The Aluminum Company of America has purchased a new factory site in Vernon, southeast of Los Angeles, and will immediately provide facilities for production of aluminum required by aircraft manufacturers of that section. Thompson Products Inc. late in April announced purchase of Jadson Motor Products Co., Bell, and gave assurance of enlarged facilities for the manufacture of valves and pistons. Although declining to make a positive announcement, William R. Angell, president of the Continental Aircraft Engine Co., has hinted that his company would probably establish a factory in Los Angeles soon.

NEWEST IN CLIPPERS

Is this 50-ton Boeing, which will be powered with four Wright Cyclone R-2600 engines of 1,500 hp. each. Intended for Pan American's transatlantic service, the six boats will be ready for test flights early next fall.

"AMERICAN"—Carrier of Passengers—SPECIFIES

Goodrich Tires and De-Icers Used Exclusively on all of American Airlines' Newest Luxury "Flagships"

FROM carrying a little more than a thousand passengers its first year, American Airlines has steadily climbed in importance, transporting more than 255,000 passengers in 1936 alone. Between 7 and 32 "American" planes are now in the air every minute of the day and night, radiating from 57 principal cities and spanning 6,715 miles of route.

This puts a responsibility upon "American" which it meets with carefully trained personnel, the latest in equipment and every known safety device. When Goodrich developed the *De-Icer*, American Airlines was among the first to give its passengers this vital protection on winter and high altitude flights. And "American" specifies Goodrich Airplane Silvertown Tires for extra safety and smoothness on landings and take offs.

Today more than ever, plane makers, large and small, and air lines all over the world turn to Goodrich for safer tires, for protection against ice and for more than 40 other products specially made to increase the safety and efficiency of their planes. Whether you're building a single plane or planning a fleet of super-liners, Goodrich has the experience and equipment you need. See your nearest Goodrich dealer or write, Dept 634, Aeronautical Division of The B. F. Goodrich Co., Akron, Ohio, for complete information.

ONE OF "AMERICAN'S" OLD-TIME FLEET In the early days American Airlines flew its passengers in these Goodrich equipped tri-motored Ford Transports—well known for their leading role in popularizing air travel. Last February "American" flew its millionth passenger—and that plane, too, was Goodrich-equipped!

NO ICE CAN STAY. The continuous inflation and deflation of the huge wing "shoes" shown above on this American Airlines plane—allows ice no foothold. Ice is cracked and blown away as soon as it forms. And—protecting still another vital point—the Spinner and Slinger Ring assembly developed by Goodrich, keeps propellers and hubs free from dangerous ice formations. Aviation engineers acclaim the Goodrich De-Icer as one of the most outstanding contributions to safety ever protection now used by air lines all over the world.

More than a Million GOODRICH FOR SAFETY

AMERICAN AIRLINES' SLEEPERS—OLD AND NEW *Above*—One of the Goodrich-equipped Curtiss Wright Condors with which American Airlines established the nation's first trans-continental sleeper plane service in 1933. *Below*—One of American Airlines' 3 giant new Douglas Flagship Sleeper Planes operating overnight between New York and Los Angeles with luxurious sleeping accommodations for 14. That great fleet along with 17 luxurious Flagship Club Planes for day flights are *all Goodrich equipped for safety.*

504 SAFE LANDINGS AND TAKE-OFFS EVERY 24 HOURS. There's lost motion in ordinary day's work for the many Goodrich Airplane Silvertowns used on American Airlines' planes. 504 times a day these husky, pillow-soft tires give safety and smooth landing to American passengers on every type of landing terrain—turf, concrete, macadam, oil runways, cinders and gravel.

Goodrich *Airplane* Silvertowns

THE SAFEST AIRPLANE TIRE EVER BUILT

Over 40 Rubber Products for Airplanes—Including Tires—Tail Wheels—Abrasion Shoes—De Icers—Matting—Rubber Hose—Grommets—Shock Absorber Cord—A Complete Line of Rubber Aeronautical Accessories.

Hindenburg Burns—

First trip of season ends in tragedy. Investigations seek cause.

NO SHADOW FOREWARNED THE WORLD of flaming disaster when the Zeppelin Hindenburg shuttled calmly back and forth across the Atlantic last year But her first trip of a scheduled eighteen for this season also proved to be her last—and wrote what seemed like a black "finis" in smoke for the efforts of American lighter-than-air die-hards

Originally due to dock at Lakehurst Naval Air Station about six o'clock on the morning of May 6, the vast dirigible actually didn't arrive at the field until 4.15 in the afternoon, having been delayed by headwinds across the boisterous North Atlantic, then high winds prevented her landing, and Capt Max Pruss, her commander, headed out to sea A little after seven, thunderstorms over the station moved off, and the ship was brought in for a landing

But she never officially did land At 7.20 her mooring lines were dropped, and a ground crew of some 200 began walking her to the mast At 7.23 a muffled explosion and a rush of flame sang spectators to the realization of the holocaust to come And at 7.23.32—just 32 terrible seconds later—the proud Hindenburg was a crumpled mass of smoking junk

Of the 97 passengers and crew aboard 35 lost their lives, including the veteran Capt Ernst A Lehmann who was aboard in an advisory capacity That the other 62 escaped seemed little short of miraculous, considering the speed of the tragedy, the intensity of the hydrogen fire, and the completeness of the destruction

Immediately investigating boards descended on Lakehurst. From Washington, appointed by Commerce Secretary Roper, came a committee headed by South Trimble, Jr., Commerce Department Solicitor and assisted by Maj R W. Schroeder Assistant Director of the Bureau of Air Commerce, and Denis Mulligan, chief of the regulations and enforcement division of the Bureau Four technical advisors were asked to assist: Commander Charles E Rosendahl, America's No 1 airship protagonist and commandant of the Naval Air Station at Lakehurst Lieut Col E. de F Chandler, U S A (ret.); Col Harold E Harney, technical advisor to Senator Copeland's Air Safety Committee and Gill Robb Wilson, Aviation Commissioner for New Jersey

This board opened hearings into the cause of the accident on May 10 Consensus of opinion, as this goes to press, is that the primary cause of the fire was the use of hydrogen as the lifting agent Secondary cause—what made the hydrogen catch fire—is as yet undetermined. A number of theories have been advanced: static electricity accumulated during the thunderstorm; sparks from the exhaust of the after port engine, near which the fire apparently started a propeller failure induced when the engine was reversed to check forward way, which ripped into the frame and severed electrical connections

A Navy board of inquiry, headed by Capt Gordon W. Hines, was to hold its hearings after the Commerce board got through and official Navy interest concerns only Navy angles possible blame attached to Navy personnel and extent of loss to Navy property

May 14 a German commission joined forces with the American board The German group, headed by Dr Hugo Eckener, 68-year-old dean of airship experts, arrived in New York May 13 and proceeded immediately to Lakehurst. Besides Eckener, it consisted of Dr Ludwig Duerr, chief construction engineer for the German Zeppelin Company Dr Guenther Bock, Professor of Aerodynamics at the Charlottenburg Technical Institute, Professor Max Dieckmann radio expert Friedrich Hoffman of the German Research Bureau, and Lieut-Col Joachim Breithaupt of the German Air Ministry.

Meanwhile a clamor arose over helium, that now magic word meaning safety from fire and explosion—and about eight per cent less lift and five times higher cost than hydrogen. German dirigible technique (valving heavily during descent) dictates use of the less expensive gas But helium, practically speaking, is a U S. monopoly, requires the approval of three cabinet members to allow its sale abroad

Recently a liberalizing amendment to the law restricting export was rushed from its Senate committee, but even if it passes, the biggest obstacle to use of helium would still be cost—first cost as well as the loss of payload

Martin: Ocean Flier

Marks 25th anniversary of Catalina flight, pilots China Clipper

TWENTY-FIVE YEARS of seaplane designing and flying was celebrated May 10 by Glenn L. Martin. To mark the day, he flew the China Clipper, product of his own brain and factory, and loaned for the occasion by Pan American Airways, from Newport Beach, Cal., to Santa Catalina Island With him went his mother who in 1912 when he flew

CLIPPER BUILDER MARTIN

Waves from the bow of the China Clipper, which May 10 ha flew from the mainland to Santa Catalina Island to repeat an accomplishment of 25 years ago.

Wide World

LOCKHEED FOR STRATOSPHERE

Long a secret project for the Army Air Corps, this sealed-cabin Lockheed, powered with two twin row Wasp engines will be ready for delivery in June.

over the same course to make the first over-ocean airplane flight, fastened in bamboo struts with silk thread and hairpins

Porterfield Moves

INCREASED SPACE to permit the production of three ships daily was announced May 15 by the Porterfield Aircraft Corp The new factory at Kansas City, Mo, contains more than 50,000 sq ft of floor space was necessitated by the largest order backlog in the company's history

Races and Records—

Endless Caverns offers prize; judges picked for St. Louis contest

THE ENDLESS CAVERNS AIRPORT, Endless Caverns, Va, which last year established an air record foundation has announced the posting of a cash prize of $1,000 for any American pilot who, this summer on the Endless Caverns Speed Course, will bring back to the United States the 100 kilometer speed record now held by France at 295 97f m p h

Chief Judge of the first International Aerobatic Competition to be held in connection with the St Louis Air Races, at Lambert St. Louis Airport, May 29-31, was to be Major Alford J Williams, according to James Rowan Ewing, managing director of the meet. Williams was to fly his Grumman pursuit, Gulfhawk, in exhibition aerobatic maneuvers, though, of course, he would not compete Other judges were to be Major James H Doolittle, Lieut Col Philip R Love and Lieut. Cmdr. D W Tomlinson Entered for a crack at the world landplane speed record was Major Alexander de Seversky, flying a specially built Seversky Also entered for speed races were Mrs Louise Thaden, winner of the Bendix Transcontinental Race last Fall, and Marion McKeen

Newest Bellanca—

Five place ship for medium price field will be in-line powered

BELLANCA AIRCRAFT CORPORATION, New Castle, Del, have released preliminary information on a new five place low-wing monoplane. Designated 17-20, it has been designed for the medium priced, private market ft incorporates a stressed skin monocoque metal fuselage, and will be powered with a "well-known American inline motor"—presumably the Menasco, of which five have been delivered Fuselage construction is said to be unique, eliminating many small parts and obviating the difficulties of compound curves

Navy Buys Planes

Two NAVY ORDERS FOR AIRPLANES were announced in May The first, for fifteen amphibians for general utility purposes (VJ-class) was awarded to the Grumman Aircraft Engineering Corp, Farmingdale, N Y at a contract price of $571,923

The second contract went to Curtiss Airplane Division of Curtiss-Wright Corp at Buffalo, N Y, was for 83 scouting-observation planes (VSO) costing $2,119,687

Orders Mount—

Year's first three months show production totalling $20,500,000, augurring prosperous year

A RECENT REPORT by Leighton W Rogers, President of the Aeronautical Chamber, disclosed that total sales of American Aircraft, engines, and spare parts for the first three months of this year were valued at $20,500,000 This is a 67 9 per cent increase over the same period last year, and seems to point to an exceptionally prosperous year for the industry

Increased activity has been noted in many plants during the last month

Lockheed Orders—Reports from the Lockheed Aircraft Corporation indicate that a new airline between Auckland and Wellington, New Zealand will be in operation shortly Union Airways, Ltd of New Zealand, a subsidiary of Union Steamship Co, have ordered three Electras, two of which were scheduled for delivery late in April and the third late in May The ships are standard ten-passenger Electras powered with Pratt & Whitney Wasp engines They cost in the neighborhood of $165,000 Aloye W Stephens, Lockheed pilot, was to accompany the planes to their destination in order to familiarize pilots of the new line with their operation

Orders for the Model 14, not yet test flown, mounted to 19 with Northwest Airlines taking 8, KLM and KNfLM 6 an unannounced Eastern airline and private or corporate customers 5 One of the private buyers of the new model f4, Lorenz Iversen, is installing two G 105 Cyclone engines to attain an estimated cruising speed of 280 miles per hour The Pittsburgh manufacturer will use this plane for personal travel

400 a Month—The Taylor Aircraft Co. of Bradford, Pa, is laying plans to produce Cubs at the rate of 400 a

month. At the end of 1936 capacity of the plant was 200 airplanes per month but on March 16 fire nearly leveled the plant and it will be entirely rebuilt. According to sales manager Ted Weld, it will take 800 employees to turn out 400 planes each month.

The Wright Way—Wright Aeronautical Corporation will spend $1,350,000 for additions to its engine plant at Paterson, N. J., according to announcement by President Guy W. Vaughan. About $500,000 of this will go for new machine tools and a new four-story factory wing. Two new engine testing cells are also included in the program for engines up to 1,800 hp.

Aeroneer—James A. Phillips, Jr., president of the Aero Engineering Corp., Los Angeles, has reported that the company expects its A.T.C. on the Aeroneer shortly. First production schedule calls for 25 ships, on which more than 100 men will be employed. It is expected that these first production models will be available for delivery early in August.

New Factory—The contract has been let for a $2,000,000 expansion program at The Glenn L. Martin Co. in Baltimore. It will add 256,000 sq. ft. to the available floor space, including a new assembly unit with an unobstructed floor measuring 300x450 ft. and with head room of 40 ft.

Further and Faster—

Airlines speed up schedules, lengthen flights, consolidate routes

LATEST move in the fight against airline accidents is an announced experimentation with the Lorenz blind landing system. Apparatus for the system has been installed by the International Telephone & Telegraph Corporation at the Indianapolis Municipal Airport where American, Eastern and TWA will make tests with it. Extensive use of the system is made in Europe. The equipment at Indianapolis is under the direction of Dr. Ernst Kramar.

FASTEST—The battle over which airline provides fastest service from East Coast to West Coast continues. April 25 American Airlines took the lead with a 17 hr. 20 min. schedule on the Skysleeper American Mercury. The speed up was accomplished by shifting the route to go through the new airport in Nashville instead of stopping at Memphis, thus cutting 20 minutes from the previous schedule. But American did not hold the lead very long. Five days later, on May 1, TWA sliced 31 minutes from the schedule of the Westbound Sky Chief, bringing the time down to 17 hr. 8 min.

Great Gains—American Airlines has reported an increase of 44 per cent in passenger revenue for March 1937 over March 1936, and a 34 per cent gain over February 1937. Passenger miles for the month were 8,921,498, as compared with 6,615,802 in March 1936. Seating capacity, according to President C. R. Smith, has been increased 70 per cent over that available last year.

Non-Stop—A shift in scheduled stops on Eastern Air Lines' New York-Miami run took effect April 15. Henceforth the only stop on the run will be at Washington. Previously it was a one-stop run with a refueling halt at Charleston. This one-stop schedule the "Pan American Express" is operated with a Douglas DC-3 21-passenger ship. Route mileage between Washington and Miami is 989 miles.

Ten-Year Cake—Pennsylvania-Central Airlines celebrated its tenth birthday, April 21, by serving birthday cake to local dignitaries and passengers at all scheduled stops.

Spanish Speakers—Braniff Airways will require of its hostesses the ability to speak Spanish. This is because many of its passengers coming through the Brownsville gateway, are natives of Mexico or Latin America. The line will shortly place in service five Douglas DC-2's purchased from TWA.

NPA to WAE—Approval has been given by the Post Office Department for the transfer of National Parks Airways' mail contract to Western Air Express. This will give WAE a route extending from Great Falls, Montana, by way of Butte and Salt Lake City to San Diego.

Men for Jobs—

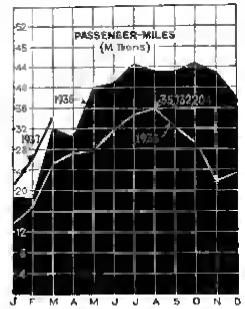
Schools face heavy demands from the industry for trained men

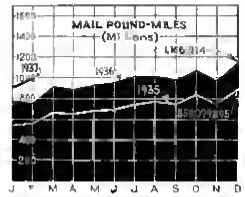
CONTINUED HEAVY DEMAND from the aircraft manufacturing plants for trained workers finds the country's air schools hard put to it to keep up the supply. Frequently practically all the schools' graduating classes are absorbed at once.

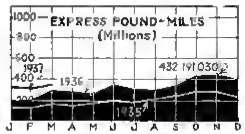
This year's winner of the annual W. E. Boeing Scholarship, awarded by the Boeing School of Aeronautics at Oakland, Cal., is R. Dickson Spears, of Massachusetts Institute of Tech-

Traffic

Latest available statistics from the Bureau of Air Commerce and the Post Office Department—Domestic airlines only







AIR TRANSPORT INDICATOR

May 1, 1937

105.5

—which is the ratio of revenue passenger miles for April 1937 as compared with the corresponding figure for April 1936.

For March 1937 the indicator stood at 107.

TAYLORCRAFT SALES MOUNT

C. G Taylor, the company's president, reports orders for 256 ships in the first four and a half months of the company's existence Nore Nat Kehn, (left) of Jersey Air Service, northeastern Taylorcraft distributor, watches as two Taylorcraft purchasers shake hands.

nology. His prize is the Boeing Airline Pilot and Air Transport Engineering course, the tuition value of which is $6,040. Second place went to Robert T. Lamson, of the University of Washington; third, to William A. Wichers, Hope College, Holland, Mich.; fourth, George I. Hayes, Riverside Junior College, Riverside, Cal.

Newest addition to the flying equipment at Parks Air College, E. St. Louis, Ill., is a 1937 Stinson Reliant, SR9B, powered with a 245-hp. Lycoming engine.

Extensive practical navigational training is assured at the Ryan School of Aeronautics, Lindbergh Field, San Diego, Cal., by the organization of week-end trips to San Francisco, Las Vegas, and Tucson. These training flights have been under the direction of Robert Kerlinger, Ryan flight instructor. The return trip on all flights is laid out over a different course to provide the greatest amount of navigational experience.

Student-instructor at the Hobley-Maynard Air Service, Inc., Shushan Airport, New Orleans, is Miss Edna M. Gardner. Her air experience totals 1,800 hours and she has soloed 71 students. Newest addition to the Hobley-Maynard flying fleet is a Taylorcraft, which was scheduled for delivery in April.

Since Jan. 1, 1937, 42 graduates of Roosevelt Aviation School, Roosevelt Field, Mineola, N. Y., have been placed in positions in the industry. The next term at Roosevelt School starts July 6.

Joe Plosser, president of Grand Central Flying School, Glendale, Cal., reports record Spring enrollment, especially in solo flying. So heavy has been the demand for equipment that Plosser reports four successive week-ends when all equipment was sold out for the day and a waiting list remained.

Lindbergh Flight—

Tenth anniversary marked by two New York gatherings May 20

To CELEBRATE the tenth anniversary of Charles A. Lindbergh's flight to Paris May 20, 1927, two events were scheduled for that date in New York. First was a luncheon—a sort of reunion of the men who worked with Lindbergh in his flight preparations or were associated with him on his return. On the evening of May 20 The Committee for the Celebration of the Tenth Anniversary of the First New York-Paris Flight, with the cooperation of the Aeronautical Chamber of Commerce, the National Aeronautic Association, and the Institute of the Aeronautical Sciences sponsored a dinner in Colonel Lindbergh's honor. Chairman of the Committee, which includes over 150 top U. S. names was Maj. Gen. James B. Harbord.

Loening Appointed

Kennedy names him Maritime Commission aeronautical adviser

OLD-TIME DESIGNER GROVER LOENING has been appointed by Chairman Joseph P. Kennedy to be aeronautical adviser to the Maritime Commission. It will be Loening's responsibility, in his newly created post, to conduct the Commission's studies of the use of aircraft—both lighter and heavier than air—in conjunction with the Merchant Marine.

Paris Race Off—

Bureau will not sanction Lindbergh memorial flight

OPPOSITION to the French government-sponsored Lindbergh Memorial Air Race from New York to Paris took a positive turn late in April, when the Bureau of Air Commerce announced that it would refuse to sanction it. Col. J. Monroe Johnson, Assistant Commerce Secretary, who has often expressed disapproval of "stunt" flights, said that "no matter what the mechanics of the thing are, there will be no air race." What authority the Bureau will exercise to prevent it is as yet undecided. But that a way will be found is evident in the fact that the State Department has notified the French Embassy in Washington that the Commerce Department will not permit a start from American soil.

Earnings for Eight—

The trend to profits continues as manufacturers report

RECOVERY SEEMS definitely to be catching up with depression as eight companies report profits, many of them substantial. Herewith the record for the month:

(*Continued on page 61*)

Calendar

May 26-June 6—First Salon International de Aeronautique, Palais du Centaine, Belgium.

June 12-20—International Air Show, International Amphitheatre, Chicago, Ill.

June 26-July 10—Eighth Annual Soaring Meet (International), Elmira, N. Y.

July 23-Aug. 1—Fourth International Aviation Meeting, Zurich, Switzerland.

Sept. 3-5—National Air Races, Cleveland, Ohio.

Oct. 7-9—SAE National Aircraft Production Meeting, Los Angeles, Cal.

(Continued from page 58)

UNITED AIRCRAFT CORP.—For the quarter ended March 31, net profit $698 852. This compares with $350 952 for the same period a year ago.

NORTH AMERICAN AVIATION, INC.—Consolidated net profit for the three months ended March 31, $70 318. Unfilled orders of the engineering and manufacturing divisions amounted to $6 013,556 against $1 094,838 a year before.

MACWHITE COMPANY.—Net income for 1936 of $267,730 against $182 704 for 1935.

RYAN AERONAUTICAL CO.—Net profits of $4 233 for 1936.

BREWSTER AERONAUTICAL CORP.—Net income for 1936 $46,416, equal to 29 cents each on 162 500 common shares against $5 621 or 3 cents a common share in 1935. After deducting federal surtax on undistributed earnings net income for 1936 was $36 866, or 23 cents a common share.

NATIONAL AVIATION.—Reported a net profit of $144 588 for the quarter ended March 31 after expenses and normal federal income taxes and including $153 332 net profit on sales of securities. This report did not take into consideration provision for surtax on undistributed profits. Net profits for the quarter a year ago was $351 296.

BEECH AIRCRAFT.—For period from Sept 17 to Dec 31 1936, net loss $3,227.

THE GLENN L. MARTIN CO.—Net earnings for the first quarter of 1937, $339 469. Unfilled order backlog as of March 31 totaled $11 002,340.

BENDIX AVIATION CORP.—For the March quarter a net profit of $806-50?, equal to 38 cents each on 2 097,663 shares of $5 par capital stock against $860,820, or 41 cents a share for the corresponding first quarter of 1936.

NACA Conference

Twelfth annual meeting reveals new free flight tunnel

THE NACA's TWELFTH ANNUAL AIRCRAFT Engineering Research Conference was held at Langley Field May 18 and 20. It was held in two sections because of the number of aeronautical people attending.

Among the new exhibits was a free flight wind tunnel as well as a free flight arrangement for measuring the character and effect of atmospheric gusts.

Deliveries

AVIATION'S report of commercial airplane deliveries for the month ended May 10, 1937.

Purchaser and Number of Units	Type of Buyer	Manufacturer	Model	Engine Make and Model
A. B. Gustavarkus E	Fixed Base	Rearwin	9000	Warner Scarab Jr
Aeroposta (2) E	Air Line	Lockheed	Electra	Wasp Jr. SB
African Flying Ser. E	Fixed Base	Ryan	S-T-A	Menasco C4
*Aircraft Exchange (4)	Corporate	Arrow	F	Arrow F V-8
Air Services Inc	Fixed Base	Stinson	SR-9-BD	Lycoming R-680-D5
*Amer. Eastern Aviation E	Corporate	Stinson	SR-6D	Wright R-760-E1
Amsterdam Flying Ser	Fixed Base	Taylor	Cub J2	Continental
*Baillie, F. W. E	Private	Arrow	F	Arrow F V-8
Baldwin, J. W	Corporate	Stinson	SR-9-BD	Lycoming R-680-D5
Batchelor, B	Fixed Base	Taylor	Cub J2	Continental
*Bayside Flying Ser	Fixed Base	Taylor	Cub J2	Continental
*B. C. B. Flying Ser	Private	Arrow	F	Arrow F V-8
*Bonanno, George	Private	Arrow	F	Arrow F V-8
Booth-Henning, Inc	Fixed Base	Stinson	SR-8-ED	Wright R-760-E2
Brayton Flying Ser	Fixed Base	Ryan	S-T-A	Menasco C4
Brown, Lyman Crawford	Private	Rearwin	9000-L	LeBlond 5F
Bughee, Maurice	Fixed Base	Taylor	Cub J2	Continental
*Burke Flying Ser	Private	Arrow	F	Arrow F V-8
Canadian Dept. of Trans	Govt	Lockheed	12	Wasp Jr. SB
Chicago Aviation Corp	Fixed Base	Stinson	SR-9-BD	Lycoming R-680-D5
China Airmotive Co. E	Govt	Spartan	7W-F	P&W SB 450
*Cub Distrib. Co	Fixed Base	Taylor	Cub J2	Continental
Davis, Cecil	Fixed Base	Taylor	Cub J2	Continental
Denver Aeronautical (2)	Fixed Base	Ryan	S-T-A	Menasco C4
Dieringer, J. F	Fixed Base	Taylor	Cub J2	Continental
Eastman, Thomas	Private	Stinson	SR-9-BD	Lycoming R-680-D5
Fleet Aircraft (4) E	Fixed Base	Waco	ZQC-6	Jacobs L-5
Gebhard, O. F	Fixed Base	Taylor	Cub J2	Continental
General Air Service	Fixed Base	Rearwin	7000	LeBlond 5E
Gibson, R. L. E	Fixed Base	Rearwin	9000-L	LeBlond 5F
Haller Aviation E	Fixed Base	Ryan	S-T	Menasco B4
Heart Isl'd Trans. Co	Corporate	Stinson	SR-9-BD	Lycoming R-680-D5
Hasselbeck, M. F	Private	Stinson	SR-6B	Lycoming R-680-D6
*Huntington & Ross (2)	Corporate	Arrow	F	Arrow F V-8
*Hurd, James L	Private	Arrow	F	Arrow F V-8
Byrd, L. A	Fixed Base	Taylor	Cub J2	Continental
*Josko, Nicholas	Private	Arrow	F	Arrow F V-8
Jay, William M	Private	Stinson	SR-9-BD	Lycoming R-680-B6
*Kelroy, G. D	Private	Arrow	F	Arrow F V-8
*Kaltenkamp, E. H	Private	Arrow	F	Arrow F V-8
Lee Drilling Co	Corporate	Spartan	7W	P&W SB 450
Leach Aircraft Inc. (2)	Fixed Base	Stinson	SR-9-BD	Lycoming R-680-D5
LOT E	Air Line	Lockheed	Electra	Wasp Jr. SB
Mason, George W	Corporate	Stinson	SR-9-ED	Wright R-760-E2
McConnell, Glenn	Fixed Base	Taylor	Cub J2	Continental
Mencke, Philip	Fixed Base	Taylor	Cub J2	Continental
Miami Aero Corp. (3)	Fixed Base	Taylor	Cub J2	Continental
Moore, A. G	Fixed Base	Taylor	Cub J2	Continental
*National Air Service	Corporate	Arrow	F	Arrow F V-8
*National Flying Schools	Fixed Base	Taylor	Cub J2	Continental
Nelson Flying Ser	Fixed Base	Taylor	Cub J2	Continental
Parker, Dr. Wm	Private	Rearwin	7000	LeBlond 5E
Parks Air College	Fixed Base	Stinson	SR-9-BD	Lycoming R-680-D5
Peoria Aero Sales	Fixed Base	Taylor	Cub J2	Continental
Phillips Petroleum	Corporate	Lockheed	12	Wasp Jr. SB
Radio Frequency Lab	Corporate	Stinson	SR-9-ED	Wright R-760-E2
*Rodenberger, Ernest	Fixed Base	Taylor	Cub J2	Continental
Reynolds, Frank C	Fixed Base	Taylor	Cub J2	Continental
Robbins Co., H. C	Fixed Base	Waco	YKS-7	Jacobs L-4
Rockland Air Service	Fixed Base	Taylor	Cub J2	Continental
Ross Aircraft Inc	Fixed Base	Stinson	SR-8B	Lycoming R-680-D5
Rutherford, G. L	Fixed Base	Taylor	Cub J2	Continental
Ryan School	Fixed Base	Ryan	S-T-A	Menasco C4
*Safair, Inc (4)	Corporate	Arrow	F	Arrow F V-8
Seas, Jerry	Private	Stinson	SR-9-CD	Lycoming R-680-D5
Sanders Jr., Ralph	Fixed Base	Taylor	Cub J2	Continental
Smith Flying Ser	Fixed Base	Taylor	Cub J2	Continental
Superior Oil Co	Corporate	Lockheed	12	Wasp Jr. SB
*Swetland	Fixed Base	Taylor	Cub J2	Continental
*Territorial Exp. E (3)	Corporate	Stinson	SR-6-DM	Wright R-760-E1
Thompson Flying Ser	Fixed Base	Waco	YKS-7	Jacobs L-4
Thompson Flying Ser	Private	Waco	YKS-7	Jacobs L-4
Thompson, Theo. H	Private	Rearwin	9000-L	LeBlond 5F
Triangle Prom. (3)	Corporate	Stinson	SR-9-CD	Lycoming R-680-D5
Waco Sales of N. Y	Fixed Base	Waco	YKS-7	Jacobs L-4
*Walton, Max	Private	Arrow	F	Arrow F V-8
*Ward, A. S	Fixed Base	Taylor	Cub J2	Continental
Watson, Hugh	Fixed Base	Taylor	Cub J2	Continental
*Walston, Lt. R. L	Private	Arrow	F	Arrow F V-8
Wessel Flyveselskap E	Fixed Base	Rearwin	9000-L	LeBlond 5F
Weymouth, George T	Private	Stinson	SR-9-ED	Lycoming R-680-D5
Whitney, O. J	Fixed Base	Ryan	S-T-A	Menasco C4
Young, Hardy	Corporate	Waco	YKS-7	Jacobs L-4

Asterisks (*) indicate previous unreported deliveries made prior to April 10 1937. "E" indicates Export.

Aviation People

Who's who and what they are doing

MAJOR R. W. SCHROEDER

HOWARD F. ROUGH

CAPTAIN ERNST A. LEHMANN

BENNIE HOWARD

» During the reorganization of the Bureau of Air Commerce, news of MAJOR R. W. "SHORTY" SCHROEDER'S appointment as its first assistant director was greeted with a nod of approval by the industry. Regret at his recent resignation is tempered by the fact that he is taking an executive position in the operations department of United Air Lines. This job, because of United's energetic program of research in air safety, will give him opportunity to continue the studies along these lines which he had been supervising while with the Bureau. Major Schroeder's aeronautical connection started with exhibition work in 1910. From 1916 to 1920 he was with the Army Air Corps, during which he made the initial studies on stratosphere flying and established a world altitude record. The next five years were devoted to aviation insurance, and in 1925 he joined Ford Motor Company as superintendent of the Ford Airline. The following year found him assisting in drafting the regulations for the aircraft safety competition sponsored by the Guggenheim Foundation. Flying service and airport management engaged his attention from 1928 until 1933 when he was appointed chief of airline inspection for the Bureau of Air Commerce, recently becoming its first assistant director.

» MAJOR SCHROEDER'S post as First Assistant Director of the Bureau of Air Commerce is taken over by HOWARD F. ROUGH. He comes by it logically, having been a Department of Commerce inspector from 1928 to 1931, and supervising aeronautical inspector in the Detroit area until 1935. He then went with Gulf Refining Company of Pittsburgh as territorial manager of the aviation division, and now comes back to the Bureau. Having been with the Aeronautics Branch, as the bureau was then known, in its early period of organization under the Air Commerce Act, no stranger he to the ramifications of his new job. Stated COL. J. M. JOHNSON, Assistant Secretary of Commerce: "* * * I feel that he has a broad knowledge of the entire civil and commercial aviation field and that his appointment will be welcomed by every phase of civil aeronautics which has to do with the Bureau of Air Commerce." Mr. Rough served during the war as army pilot and instructor here and abroad.

» A great sorrow becomes more poignant through the death of CAPTAIN ERNST A. LEHMANN as the result of the Hindenburg disaster on May 6. Captain Lehmann was born at Ludwigshafen, Germany, and his early days were dedicated to the sea for which he prepared as a sea cadet on the training ship "Stosch." On termination of six years of study in ship construction at the Charlottenburg Technical College he was assigned to the Imperial Navy Yard at Kiel, and a year later (1913) was made commander of the airship "Sachsen" for the German Airship Company at Frankfort-am-Main. At the start of the World War he was continued in this command by the Army, serving as skipper of the Sachsen and four other airships until 1917. He then became manager of zeppelin construction and development work on war airships for the Navy until 1918. Peacetime found him an officer of the Luftschiffbau Zeppelin Corporation, and in 1930 he took over command of the Graf Zeppelin on its regular Atlantic flights. In 1936 he became captain of the Hindenburg which brought his career to an untimely close at the age of 51. At the time of his death Captain Lehmann was president of Deutsche Zeppelin Reederei, operating company of the Hindenburg and Graf Zeppelin. He had written numerous articles and was co-author of *"The Zeppelin."*

» Valiant is the word for BENNIE HOWARD. Fully recovered from the injuries sustained during the Bendix race last year, Howard is now pilot and flight engineer of United Air Lines' "Flying Laboratory" — the twin-engined Boeing 247D used exclusively for research and experiment. He will also collaborate with United's engineers in developing technical information, including anti-static, landing beam, and other features. During his seven years with United's eastern division Howard designed and manufactured his own Howard DGA and in 1935 won the Bendix Trophy.

» J. P. BOORE has resigned as vice-president of Summerill Tubing Company, to become assistant general manager of sales for Babcock & Wilcox Tube Company, at Beaver Falls, Pa. Steel tubing has been Mr. Boore's forte since 1913 when he entered the Pittsburgh Steel Company's plant. In 1933 he became manager of tube sales for Edgar T. Ward's Sons Company, later

**I've been asked for specifications on yarns for the Perch. Here they are: (1) If home-made—no limits to landing speeds. (2) Stock models—all landings with wheels "up." (3) Motors—Real and Imaginary Aircraft Engine Company—(any power). (4) Any fuel below 40 octane—so that we can listen to a "knock" once-in-a-while. (Get me?) (5) If you have ever seen a motor or a plane or anything else you did not want to change, do not fill in entry blank. (Get me?) (6) We have tightened our helmets and goggles and removed windshields—*CONTACT!*

MAJOR AL WILLIAMS, alias' Tattered Wing Tips," *Mgr. Aviation Dept.*, Gulf Aviation Products, Gulf Building, Pittsburgh, Pa.

CRAZY GUY FROM THE NORTH CONTREE!

A few months ago a well-known Saskatchewan airman was hauled up in court.

The judge handed him out a fine for obstructing *pedestrian* traffic on one of the principal streets of Regina. The birdman, you see, had landed at the airport and, feeling lazy, just taxied on skis down the snow-covered streets of Regina.

Since Regina is no one-horse town but a city of 50,000, you can see that the lad had his nerve to use the streets for an airplane boulevard.

The officer who arrested him said that the motor was running *and the plane was tied to a tree.* Since he had to tie the crate up, I figured he must have been using Gulf Aviation Gas—and that you would like to hear about the story.

—Jim Miller, Blodworth, Sask., Canada

STRANGE HOBBY DEPARTMENT

(Excerpt from the July Perch)

"A pilot I nominate for immortalization is Spike Callahan. Spike washes dishes for a living and, in his spare time, flies.

"Is it hard to get their ears clean, 'Spike'?

—H. L. L.

IS S. M. PULLING OUR LEG?

This pilot (whose name I'd like to know) was cruising over a small town when his engine caught fire.

Having no fire extinguisher, he bailed out. When he reached the ground, he found to his surprise that the fire had gone out and that the ship was flying in circles.

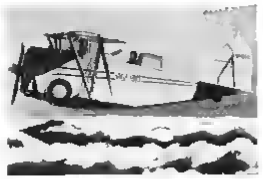
A warning was broadcast and the whole town stood amazed with eyes on the sky. Even factories shut down for fear the ship might crash through the roof.

For four hours that ship flew in endless circles. At last, with the gas supply exhausted the ship started on a downward course. And, believe it or not, that plane landed "dead stick" in an open field. It had a washed out landing gear and a smashed prop.

This incident, I believe, took place somewhere in California. Can some one verify it for me?

—S. M., Shillington, Pa.

THE EDITOR'S NEW BABY



Here's Al Williams' new Grumman G-22, powered with a 1000 h.p. Wright Cyclone engine. Besides plain and fancy flying, Al will use this ship to test Gulf's new *Aviator Oil.*

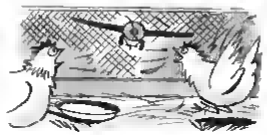
Already, tests show that this 100% Pure Pennsylvania Oil is the best ever developed for airplane use, but we want to make it still better. *Gulf Aviator Oil* is refined by the exclusive Alchlor process. Other leading oils, when re-refined by this process, give off as much as 20% black, sticky waste.

THIS MONTH'S WHOPPER

Out in Joliet, the bumble-bees are made of lead. I know, because I caught one in my hand. It was like this:

One day I was up in my plane, just horsing around, when I happened to pass over a chicken farm. Now, I love chickens. I think they're man's best friend, especially with gravy. So I swooped down low just to say hello to the biddies.

Trouble was, I got too low. So low that the fowl belles got scared and set up a terrible cluck-cluck-cadeckit.



The farmer ran out with a shot gun and I vamoosed.

Then, something funny happened. I looked out the side of the cockpit and saw a swarm of bees. They were going along at the same rate of speed that I was traveling.

Being curious, I put on a glove, reached out and grabbed a handful. Was I surprised to find that I had a handful of buckshot.

With that Gulf Aviation Gas I was using, the speed of my old Jenny was exactly the speed of the buckshot.

—"Chuck" Winston, Joliet, Illinois

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF AVIATION PRODUCTS

being made vice-president of Sumnerill, a Ward subsidiary.

» Unique but perilous was the profession which brought death to CLEM SOHN at Vincennes, France, on April 25. Sohn, who had achieved considerable renown here and abroad as "The Bat Man," had contrived a pair of specially constructed wings which he used in his parachute jumps to simulate the flight of a bird, or more accurately a bat. Failure of both chutes to open at a height of about 1,000 ft., apparently caused by fouling with the "bat wing" apparatus, resulted in his death before several hundred thousand spectators assembled at Vincennes' annual air circus. Sohn, who was 26 years old, made his home in Lansing, Mich., and had participated in air shows throughout the country, first as a parachute jumper, later with his specialty act.

» The post of advertising and publicity manager of United Aircraft Corporation, left vacant by the resignation of JOSEPH E. LOWES, JR., is filled by NORMAN V. CLEMENTS. Clements has been with United since 1932, first as advertising manager for the Chance Vought Aircraft division, more recently as associate editor of the company magazine, 'The Bee Hive.' He had previously been with Curtiss Aeroplane & Motor Company for nine years.

» JOSEPH E. LOWES, JR., became assistant director of advertising and publicity for Pratt & Whitney Aircraft in 1930, and in 1931 was made director of advertising and publicity. In 1934 he took over these duties for all the divisions of United Aircraft Corporation. His friends can now find him at the New York office of 'News Week' magazine, as circulation manager. Mr. Lowes has been chairman of the aviation committee of the Hartford Chamber of Commerce since 1934, and also chairman of the Hartford district of the National Aeronautic Association.

» Probably everyone in the industry has at one time or another turned to FRED NEELY of the Bureau of Air Commerce's Information and Statistics Division for some bit of information. News of his resignation is regretted for during his tenure as chief he had developed the information service of the Bureau to its present high efficiency. Mr. Neely's new connection is as assistant to MAJOR AL WILLIAMS, manager of Gulf Oil Corporation. Last fall Neely acted as goodwill ambassador for the Bureau on a 15,000 mile flight through the West Indies, South America, Canal Zone, Central America, and Mexico.

» DOUGLAS ROBINSON has rejoined Kellett Autogiro Corporation after an absence of several years in the aviation insurance business in New York. He will devote his activities to autogiro sales, with headquarters in Philadelphia and Washington.

» COLONEL DEAN J. LAMB is now factory representative and eastern representative for Maynard Di Cesare Propeller Corporation. In 1918 Colonel Lamb was assistant editor of AVIATION, and for the past five years has been doing private flying and experimental work.

» In 1929 CHARLES E. BEARD helped to organize the first consolidated airline ticket office in the world, at Chicago. In October, 1935, he was made General Traffic Manager for Braniff Airways, and has now been elected to its board of directors and as vice-president in charge of traffic, advertising and publicity. He will direct the work from the Braniff Building in Oklahoma City.

NORMAN V. CLEMENTS

JOSEPH E. LOWES, JR.

FREDERICK B. NEELY

» H. A. BEILGARD, well known on the West Coast and a pioneer in the development of retractable landing lights, has been named manager of The Daleo Company, Long Beach, Cal., builders of Dalco hydraulic landing lights.

» The Mackay Trophy and the Cheney Award for 1936 were presented at Bolling Field on May 8. The Mackay Trophy, for the most meritorious flight of the year, went to nine officers and enlisted men who flew three B-10-B bombers from Langley Field to Allegan, Mich. during the Second Army maneuvers last August. Despite adverse weather, the planes made a simulated attack at night on anti-aircraft installations, and then proceeded through heavy rain-storms to Selfridge Field. The Cheney Award for outstanding acts of valor went to MAJOR FREDERICK D. LYNCH and Staff Sergeant JOSEPH L. MURRAY for the rescue of two men of the crew in their free balloon which caught fire during a forced landing on a flight from Fort Sill on July 10, 1936.

» Trekkers to the U. S.: HENRI MIGNET "Pon-de-Ciel's" papa, on his first visit to observe progress of his brain child here. . . . GRIFFITH BREWER of London, old friend of the Wrights. . . . CAPT. W. VISULYA and CAPT. R. VISIAKAM of the Royal Siamese Air Force. . . . LT. ROBERT BLACK, back from two years in China as instructor in the Chinese Air Force, now with the Air Corps at Mitchel Field. . . . ING. KARL SEYBOTH, editor of *Der Deutsche Sportflieger,"* who carried to study private flying and light airplanes after the departure of his co-travellers the German Aero Club who were touring aviation centers. . . . MARTIN WRONSKY, director and business manager of Lufthansa. . . . O. J. WHITNEY, president of O. J. Whitney, Inc., who returned sun-tanned and minus the Beechcraft C-17B which he had flown through 14 Central and South American countries for delivery to COUNT CRESPI of Sao Paulo. . . . CAPTAIN MARCON A. ZAR, director of Naval Aviation for the Argentine government, who is in Washington arranging the contracts for aviation materials to be purchased by his government.

Stress Ratios

(*Continued from page 43*)

being equal. This method is based on the assumption that the magnitude of all stresses increases proportionally, which is usually the case when weights or load factors are increased and when secondary effects are absent

Tube Problems

1. *Bending and Compression* (Round tubes) One of the first appearances of the typical combined loading curve is found in Reference 1, where nondimensional stress ratios were plotted against each other. Fig 8 of that report is reproduced here as Fig. 4. These curves are based on tests that were made with transverse loading at the third points, leaving some doubt as to their applicability to other types of loading. Each curve in this figure represents, in effect, a tube of different slenderness ratio. The wide displacement of the curves on the left side is due to the fact that the applied compressive stress, F_c, was divided by the limiting column stress for short columns, not by the actual allowable column stress. As a result the interaction curves do not pass through 1.0 when $R_b = 0$

Another interesting point about Fig 4 is that the term R_b considers only the *primary* bending stress. The effects of secondary stresses (caused by the axial load acting in conjunction with the bending deflection) are indicated by the "bending" of the curves downward. When *total* bending stresses are considered we can expect a different result, as will be shown later

It is interesting to note that the formula given in the Army Handbook for the primary bending stress that can be developed when a given compressive stress is acting can be easily converted into the following stress ratio equation:

$$\frac{f_b}{F_b} = \left(1 - k\frac{f_c}{F_c}\right)\left(1 - \frac{f_c}{F_c}\right) \qquad \ldots (4)$$

or

$$\frac{f_b}{F_b} + (k+1)\frac{f_c}{F_c} - k\left(\frac{f_c}{F_c}\right)^2 = 1 \qquad \ldots (5)$$

$$\text{Where } k = \sqrt{\frac{L/\rho - 30}{L/\rho}}$$

This formula gives results that are in substantial agreement with Fig 4

For engineering convenience, the non-dimensional curves of Ref. 1 were converted to a dimensional form based on actual stresses, so that the margin of safety could be more easily obtained. In that form they were used for years for steel and aluminum alloy tubing and were included in both military and commercial airplane requirements. (For instance, they appeared in *Aero Bulletin No 7-A* in 1929) In 1933 the *non-dimensional* curves were reproduced in Aeronautics Bulletin No. 7-A, together with the method of obtaining a linear margin of safety, previously described.

On account of the use of "precise" equations for computing total bending stresses many attempts have been made to convert the curves of Fig 4 to this basis, that is, to include secondary bending in the term f_b. A simple solution, consisting of a single straight line curve, was indicated in Aeronautics Bulletin No. 26 in 1934. Previous to that time Roy A. Miller, of Consolidated Aircraft, had developed a stress-ratio formula which was adopted by the Army Air Corps. This formula can be rewritten as follows:

$$\frac{f_b^2}{F_b} + \frac{f_c}{F_c} = 1 \qquad \ldots (6)$$

This result can also be obtained from Eq 4 by assuming $L/\rho = \infty$, (this gives the most conservative interaction curve) and rewriting the equation as follows:

$$\left(\frac{1}{1 - \frac{f_c}{F_c}}\right)^2 \frac{f_b}{F_b} + \frac{f_c}{F_c} = 1 \qquad \ldots (7)$$

The bracketed expression in the first term will be recognized as an approximate factor for converting the maximum primary bending stress (due to uniform lateral loading or concentrated loads at the third points) to the maximum *total* bending stress. Thus Eq. 7 reduces directly to Eq. 6

Eq. 6 is a simple way of expressing the so-called "Add Area" method discussed in Ref. 4. The following statement is quoted from that book: "We find, therefore, that the rational process of design [of columns subjected to transverse loadings] is to add to the area required by the column formula, the area required as a beam . . . using the usual value of the allowable stress"

It is easily demonstrated by simple calculations that Eq. 6 is actually a mathematical statement of the above quotation, which, incidentally, dates back to 1916

An analysis of the available data has shown that in general Eq. 6 is conservative. It seems likely that a family of interaction curves of a general parabolic type (such as shown in Fig. 5) can eventually be established to give a method of analysis that is more rational and more accurate than any that have been discussed. Each such curve will correspond to a given slenderness ratio factor B

2. *Bending and Torsion.* (Round tubes) Although various methods of attack on this problem have been employed, the stress-ratio method seems to offer the most useful solution. The illustrative case already discussed, together with Fig. 2, tells practically all the story here. The simple circular arc can even be shown (by some mathematical manipulation) to represent the identical solution obtained by other investigators who considered actual normal stresses and allowed for the angle at which they acted, in determining the allowable normal stresses.

3. *Bending and Transverse Shear* (Thin-walled circular cylinders) The convenience of the stress-ratio method can be graphically illustrated by applying it to the results obtained in Ref. 5. Fig. 8 of that report is reproduced here as Fig. 6. When converted into the stress-ratio system the result is again the single circular arc shown in Fig. 3. This can be verified mathematically from the equations derived in the report, as equations (14) to (17) of Ref. 5 reduce to:

$$R_s = \sin\theta$$

$$R_b = \cos\theta$$

which, when squared and added together give the equation

$$R_b^2 + R_s^2 = 1 \qquad \ldots (8)$$

In obtaining his results Lundquist assumed a linear stress-ratio equation in determining the conditions at the point of local buckling of the tube. It is interesting to speculate on the result that would have been obtained from a less conservative assumption. For instance, if he had used the "circular" equation the final result would have been complete independence of stress conditions, indicating that transverse shear has no effect on the allowable bending stress (assuming that the bending stresses are those caused by the shear load, of course). Actually we might expect the result to lie somewhere between these two limits and as a first guess we would assign the exponent 3 to both stress ratio terms. This would give the curve illustrated in Fig. 3 (*Cont on p. 69*)

4. *Torsion and Compression.* (Circular Cylinders) This subject is well illustrated in Ref. 6, from which Fig. 7 is taken. The solid curve shown is a cubic parabola represented by the equation

$$R_s^3 + R_c = 1.0 \qquad (9)$$

This case is unusual in that the presence of tension (denoted by negative values of R_c) actually permits the applied shearing stress to be *greater* than the allowable stress for pure torsion. This continues until the normal tensile stresses get high enough to cause trouble, whereupon a new curve (indicated by the dotted line) applies. Such action will not occur in combined bending and torsion as one side of the tube will always be in compression.

Panel Problems

Interaction curves for the elastic buckling of rectangular panels under various conditions of loading and fixity are given in Figs. 8 to 11. The basic information from which these curves were derived is contained in Ref. 2 and Ref. 7. The curves being more or less self-explanatory, the following discussion will be confined to points of special interest.

Fig. 9. An analysis of the material contained in Ref. 8 indicates substantial agreement with the interaction curve of Fig. 9, and also shows that the interaction curves for clamped edges and fixed edges are practically identical for this case.

Fig. 10. For simplicity the interaction curve for this figure was taken as a modified parabola having an exponent 1.75, although it appears that a different type of curve might give a somewhat better representation of the data. Note that the interaction curve is approximately independent of the proportions of the panel for the range considered.

Fig. 11. In this figure also, the interaction curve seems to be independent of the panel proportions. The circular arc does not give an exact representation of the data although it clearly indicates the general trend. We suspect however, that the circular arc really represents the exact solution to the problem and that the points would fall on this curve if more terms were included in the mathematical series from which the points were obtained. It is interesting to compare this case of elastic buckling with that for plastic buckling of round tubes under the analagous loading condition illustrated in Fig. 2.

Interaction Surfaces

As if two loading conditions were not enough, the designer often has to struggle with three. It is common to find (especially in control systems) that a tube is subjected to combined bending, compression and torsion. There seems to be practically no data available on this case, but since the designer had to have something we inserted a "three-dimensional" formula in Aeronautics Bulletin No. 26 in 1934. This was simply

$$R_b + R_s + R_c = 1.0 \qquad (10)$$

Since that time we have acquired enough data on other combinations of these stresses to show that the above formula was safe enough. It would probably be satisfactory to raise the exponents of R_s and R_{sc} in accordance with what we have found out about "two-dimensional" cases. Unfortunately, bending and compression seem to combine with torsion in a different manner so it is not just a matter of addition to get an equation which yields correct results with any loading condition absent. This is an interesting subject for future study and we shall only suggest an equation which does give reasonable results when either one or two conditions are missing. Its accuracy for three conditions can be determined only by tests.

$$R_s\left(1-R_c^2\right)^1 + R_c^2 + R_s = 1.0 \qquad (11)$$

We shall not attempt to include a picture of the interaction surface resulting from such an equation. The surface does actually exist, though, and will give consistent results in all four quadrants considering both positive and negative stresses. But let's drop this subject before getting involved in trying to picture *four* simultaneous loading conditions.

Other Applications

The stress-ratio method can be extended to a great variety of problems. Practically all of the theories of stress

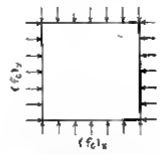


Fig. 8: Simply supported square plates under compression in two directions

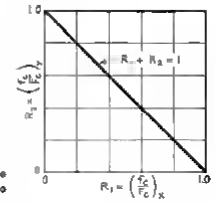
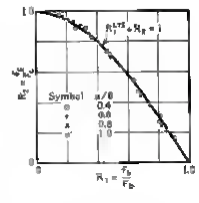


Fig. 10: Simply supported rectangular plates under combined bending and compression



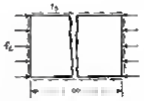


Fig. 9: Infinitely long plates with clamped edges under combined shear and compression

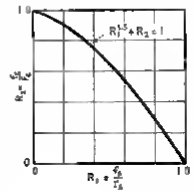
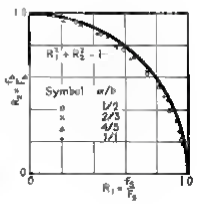


Fig. 11: Simply supported rectangular plates under combined shear and bending



failure (as contrasted to instability failure) can be expressed as interaction curves. Considering the case of a material subjected to combined shear and tension we find that both the von Mises-Henky and the "maximum shear" theories of failure give the same interaction curve, which again becomes the arc of a circle as shown in Fig 3.

An entirely differing type of problem that can be put in stress-ratio form is the bearing of bolts in wood at different angles to the grain. In this case the "simple" stress-ratios are based on the allowable bearing loads of the bolt parallel and perpendicular to the grain. The allowable bearing load at any other angle to the grain can be conveniently expressed by "combined" stress-ratios in the form of an interaction curve.

One of the ideas suggested by the stress-ratio curve is a new approach to the determination of allowable stresses for *simple* loading conditions. In plotting the data for Fig. 2, it was found in several cases that the point for simple bending fell considerably off a line fitted to the test data (See Fig 12). To give consistent results it was therefore necessary to assume values for F_s and F_a determined by the *intercepts* of this line on the two axes. It may seem far-fetched to suggest that a little torsion should be added in determining the allowable bending stress, but there might be something in the idea. Possibly further investigation will disclose a "pick-up," or effect similar to that found in the short-column range. The *intercept* method certainly applies in such cases.

To sum up: The stress-ratio has been applied to cases involving elastic stability, plastic stability, and stress (or material) failures. Although the evidence is not conclusive it appears that in many cases a single interaction curve (or surface) will apply to all of these types of failure for a given combination of loading or stress conditions. It also seems that in certain specific cases the nature of the interaction is independent of geometrical proportions and fixity conditions. The generality of these conclusions must, of course, be determined by further analysis and tests.

The inventor of the stress-ratio method, whoever he may be, has given the structural engineer an invaluable tool for handling combined stresses. There is nothing mysterious about it and it gives a picture that is often extremely helpful to an understanding of the problem. The real mystery is how such a basic principle could have remained relatively unused so long, in spite of the great need for something of this very nature. We hope that this attempt to bring it to light will help clear up at least some of the Chinese puzzles confronting the modern airplane designer.

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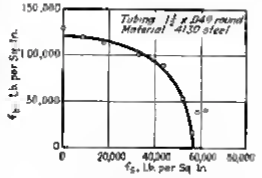


Fig 12: Determination of the interaction curve from test data

Safety Through Research

(Continued from page 21)

laboratory at Chicago field headquarters. This organization has been in existence in United Air Lines for almost ten years since Hiscock made the original experiments on two-way radiophone communication. Present chief is Herb Hucke. Besides the contributions made to de-icing, automatic piloting, and other fields mentioned above its beacon receiver is a standard unit in today's air transport operations and its airport runway localizers have proved their worth on United Air Lines and are being converted for adoption elsewhere.

One of its biggest jobs at present is the supervision of the flying laboratory, a Boeing 247D airplane assigned entirely to research and fitted with every possible gadget for experimental work in the air. Among the projects that this laboratory is undertaking now is the further study of antenna systems for the elimination of ram and snow static, also the development of automatic blind landings. Besides this work, the ship is arranged so that tests can be made on every single piece of equipment used in the air transport, engines, propellers, instruments, and a host of accessory devices. Of interest also is the fact that Benny Howard, former United pilot who was injured seriously in the 1936 Bendix trophy race, will be back in the air again as pilot of United's flying laboratory.

Thus West, Cunningham, Hucke, Howard and dozens of others are carrying forward the ideas and the ideals of Thorp Hiscock.

United has been fortunate indeed in that its management has always recognized the value of fundamental research. President Patterson is no exception. Although he is not himself a technical man, he has surrounded himself with associates of outstanding technical ability and has given them as free a hand as possible in improving and developing the service. He is always encouraging the work of the company's technical laboratories in the origination and carrying out of ideas for safer aircraft operation.

W. A. Patterson became interested in aviation through the Wells Fargo Bank, which was in charge of Pacific Air Transport's account before its absorption in the present United set-up. In 1929 he became assistant to Phil Johnson, then president of the Boeing Company, and in 1934 he advanced to the presidency of United Air Lines.

Short, dynamic and personable, Patterson is well known for his progressive attitude in company management. He has consistently followed a liberal policy in dealing with personnel and

with the welfare of his employees He realizes fully the responsibility of management toward employees and he has always listened sympathetically to suggestions He has led the way among the airlines in the establishment of a Personnel Department for taking care of suggestions, studying employee welfare His first concern is in maintaining a healthy employee management relationship To head up the personnel department, Patterson appointed Thomas B Marshall, a man of wide experience and a former member of the National Labor Board

SUPPORTING Patterson's policies is a strong back-field of men of wide experience in air transport D B Colyer as vice-president in charge of operations, has had a decade and a half of experience in air mail operations He was superintendent of air mail service of the Post Office Department when he resigned to accept a position with the old Boeing Air Transport. Harold Crary, vice-president in charge of advertising and traffic, entered aviation in 1928, as manager of the American Air Transport Association, and resigned the following year to become advertising director of Boeing He took over public relations and advertising for United in 1932 and in 1934 the supervision of traffic was added.

United's position has been further strengthened by the appointment of Major R W (Shorty) Schroeder, lately assistant director of air commerce, to be manager of operations of the line Shorty's aviation experience dates many years and his recent close contact with the transport industry while associated with the Bureau of Air Commerce is an invaluable experience for an air transport executive.

Among the old-time employees is Frank Caldwell, chief of dispatch, and meteorology A war-time pilot, he served overseas with the 141st Air Squadron and after the Armistice started flying the mail on the transcontinental route In 1927 Caldwell came with United as operations manager Long based at Cheyenne he is still known as No 1 Fisherman of the Jackson Hole area, although his present headquarters are maintained in Chicago. His assistant, chief meteorologist O T Larson, was on deck when the weather bureau set up its airways division in 1926. He served three years with the weather bureau before joining United.

Richard E Pfennig is United's director of passenger service After seven years in operations, Pfennig was appointed 18 months ago to take charge of the newly created passenger service department which includes supervision of stewardesses, passenger agents, food service, and reservations The man who worries about mail and express traffic is Russell LeBrock who has been on the job since United's formation in 1927 Before that he put in many years with the air mail division of the Post Office Department

In United's downtown Chicago office is the oldest employee of the company, C E Brink, treasurer Mr. Brink entered the employ of Boeing in 1915 and was treasurer of the Boeing Company until the formation of United Air Lines when he took over the treasury portfolio

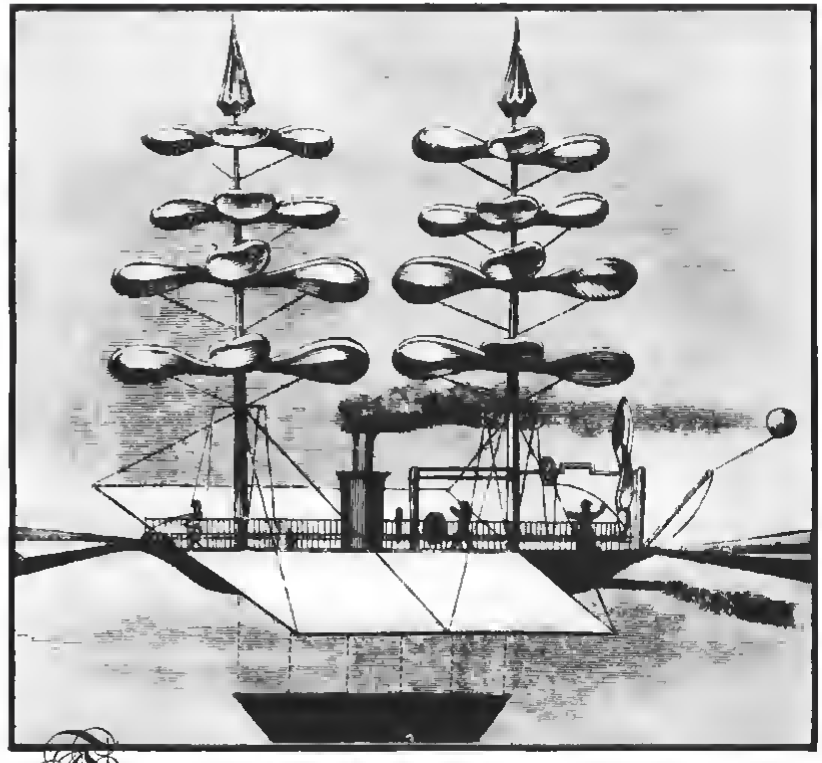
The list of division superintendents contain some well known names in aviation. Cleveland division is in charge of J A Herlihy, formerly a navy pilot, and later pilot for United on the New York-Chicago division Omaha comes under the supervision of one of the original Stout Line pilots, Ralph Reed who has accumulated at least a million miles of flight experience. Best known, perhaps, of the list, is L D Cuddeback, the pilot who first carried the mail on April 6, 1926 Cuddeback learned to fly with the Varney-San Mateo Flying School in 1921, tried to start a commercial air line in Nicaragua but was discouraged by an unintentional mix-up with a local revolution He returned to the United States to enter the early mail service He is now based at Cheyenne and directs operations on the Salt Lake Division. Pacific Coast operations are in the hands of O C Richerson, formerly a sergeant in the Air Corps during the war who in February 1920 became field manager of the old Air Mail field at Cleveland Later he was transferred to the West Coast as San Francisco field manager and he joined United Air Lines when that company took over the Transcontinental Airway in 1927

BACKBONE of any airline is the pilot staff United's flight personnel consists of 139 first pilots and 125 second pilots Chief of Flying for the system is Ragner T Freng, a million-miler who lately had charge of the automatic landing work at Oakland Under him come the four divisional chief pilots, Walter Addems in the East, Bill Wilhams for the mid-West, Harry Huking in the West, and Reuben Wagner on the Pacific. Among the first pilots today are the majority of the men who pioneered the early transcontinental airway in 1920, many of whom have well over a million miles to their credit. E "Ham" Lee is the daddy of them all in point of service, having been in air mail since 1918, and with better than 2 000 000 miles on his logbook. Jack Knight, war-time pilot, has been in the mail service since 1919, and made the first night air mail flight in 1921 Jack has also better than 2 000 000 miles Third ranking pilot in point of hours, whose flight time goes back to pre-war days, is Charles Peeples. Another veteran is Bill Williams, now chief pilot of the Midwestern division, who learned to fly before the war and who piloted the first Chicago-New York air mail. Impossible here to mention all of them, but a few others of the million-milers of the pilot staff are Frank Yager, Heber Miller, Ralph Virden, Robert Ellis, Jim Johnson, Monty Brandon, Harold Knoop, George Grogan, Remy Remelin, Werner Bunge and Geover Tyler

United in common with many other airlines is making a special appeal to women passengers A new office has been created under the traffic division director of women's traffic, a post now held by Helen Stansbury

Of such are the people who operate and who fly United's 5500 miles of airway. The services now include air mail route No 1 (New York, Chicago, San Francisco), No 11, (San Diego San Francisco, Seattle, Vancouver), No 12 (Salt Lake City to Spokane and to Portland). This great system grew from a small beginning when, on April 6, 1926, Leon D Cuddeback took off from Pasco, Wash. in a Swallow biplane to make the first flight on air mail route No 5 operated by Varney Air Lines, Inc. About the same time (May 12, 1926), National Air Transport began services down through the Middlewest between Chicago and Dallas A few months later, (September 15, 1926) Pacific Air Transport pioneered the Seattle-Los Angeles route Then in February, 1927, the contract was awarded to newly organized Boeing Air Transport to fly the mail between Chicago and San Francisco The fourth and final link of the chain which was to become United Air Lines was welded on September 1, 1927, when National Air Transport after a year's successful operation on the Chicago-Dallas route began operations between New York and Chicago

Shortly after United came into being, consolidation and standardization of operating practices were undertaken among its several operating divisions The original heterogeneous collection of airplanes which it had been operating, was in 1933 replaced with the now famous Boeing Model 247 This equipment was modernized two years later by engine and other changes and by



The father of "Aviation" had to design for steam

GABRIELLE DE LA LANDELLE frowned Flying should be on a scientific basis. The Vicomte de Pooton d'Amecourt and Felix Tournachon agreed Had he not designed the "Steam Air Liner" the year before? Now, in 1884, the three had formed a society for further study What should it be named? Slowly his pen traced "Societe de—AVIATION." The infant science was christened for all time

His "Steam Air Liner," pictured above, startled the world. Octuple air screws provided lifting power Large planes on either side were to maintain equilibrium Parachutes atop each mast were to open when needed Everything had been remembered Everything but one That had not yet been discovered—GASOLINE!

A practical power-weight ratio could not be established with a steam engine So Landelle's design became another quaint picture in aviation's history

Today, progress in aviation still depends on the inseparably linked fuel and engine Constantly better gasolines open the way to better design Even while Ethyl in aviation gasolines keeps pace and faith with present engines, Ethyl engineers are cooperating in research to bring the planes of tomorrow nearer Ethyl Gasoline Corporation, Chrysler Building, New York, N Y.

the Spring of 1937, further replacements were undertaken so that all major schedules of United are now being operated with the latest in flying equipment, the Douglas DC-3s. Boeing 247Ds are still in service for some local schedules, but all through services are operated with the larger ships.

WITH THE MOVE towards standardization and uniformity of equipment, it is possible to consolidate many of the old operations and maintenance bases. Four separate overhaul and repair plants had been maintained by the earlier operating divisions, but a number of years ago they were all consolidated into a central plant at Cheyenne, Wyo., where every airplane in the system is routed to be overhauled at periodic intervals. The Cheyenne plant is now one of the largest overhaul and repair bases for aircraft in the world. Some 500 employees are regularly engaged in this type of work at that point. Bill Hoare is in charge.

United's operations over the last five years yield interesting contrasts, and indicate the general progress of air transport. When we first went to Cheyenne in the Spring of 1932, part of the trip was made in Fords, part in Boeing's 80s, part in a Boeing Mono mail and at that time they were plenty of Boeing 40s and Boeing 95s still in service up and down the line. Making the trip today, one goes to Chicago non-stop in one of the luxurious 14-passenger Mainliners, and from there on in a 21-passenger DC3. Very shortly the DST's with their luxurious sleeping accommodations will be available over these same routes. We used to think it was something to make the trip from Chicago in seven or eight hours with stops at Toledo, Cleveland and possibly Kylertown—all the while cramped in a narrow seat and with ears constantly assailed by the roar of three Wasps. Several weeks ago we made the same run in three hours and 25 minutes (a little ahead of time to be sure, on account of a good tail wind aloft). Regular schedule is three hours and 55 minutes), high up above the weather at 11,000 ft., seated comfortably in a large swiveling armchair with plenty of room to stretch out and relax. The noise level was about the same as in a Pullman car and the excellent meal served during the trip could be stacked up against anything to be found on most railroad diners.

The serving of food in the air has become important enough (last year United served 375,000 meals to the one of a quarter of a million dollars) to warrant the creation of a new title "Maitre d'airline," a post now held by Donald Magarrell, formerly vice president of a food consulting corporation. Gone are the cardboard boxes and the sandwich-and-apple picnic lunch. Silverware, linen and porcelain plates, cups and saucers, are regular equipment on the Mainliners.

Quite a problem to serve 14 or 21 people out of a 3x6 kitchen, but the United stewardesses are turning the trick every day. Three classifications of meals are provided, A, B and C. The A meal is a complete dinner served at noon and at the evening dinner hour. A typical "A" meal includes choice of fresh fruit or shrimp cocktail, celery hearts and mixed olives, choice of fried chicken or lamb chops, potato, fresh vegetables, salad and dessert. Usually there is a choice of dessert including ice cream with cake or such things as Bavarian cream pudding, apple pie and cheese. The B lunch is a mid-afternoon snack of sandwiches, fruits, cheese and cake. Another type B meal served before bed-time consists of fresh fruit, fruit juices, sandwiches and cookies. For breakfast, the C type meal, the air traveler has a choice of five different kinds of breakfast food, fresh or stewed fruit, and, for the first time, scrambled eggs and ham or bacon. In summertime lemonade and Coca-Cola are also available and night flying passengers may obtain caffeinless coffee. The hot foods are provided at stations on the ground and are kept warm in flight in special thermos containers.

There is a saying current among United personnel that the line serves the longest meal in the world,—"200 miles from soup to nuts."

Airport or White Elephant?

(Continued from page 25)

plan. The result has been twofold: wasted capital and a poor layout. Realization of the airport shortcomings and the fear that transport activity would be transferred elsewhere is forcing expensive and drastic changes at the airport. A new hangar 1,000 ft. long is being built on the western portion of the northern airport boundary. It is planned to move or to demolish the four original hangars now situated in front of the new $600,000 airway station (between it and the landing area) to permit effective use of the new station and to make possible the use of the proposed new runway plan which almost entirely changes the present layout. A change in an airport runway layout usually means highly expensive changes in the landing area drainage structures.

In spite of its poor layout 265,282 paid airline passengers passed through the airport in 1936, such heavy traffic making drastic changes in the airport layout mandatory.

SIMILARLY the Paris airport of Le Bourget is now in process of drastic modernization to make possible the doubling of the present landing area to the southwest and to the north, over a dozen existing hangars and several dozen workshops and other airport buildings will be torn down, two large hangars having already been demolished on the site of the 720 foot long airway station now being built.

Likewise Tempelhof, the commercial airport at Berlin is being doubled in area, extension being to the north of the present landing area, and another airway station to replace the existing station is being built in the northwest angle of the expanded airport. This airport expansion will leave the present 345 ft. long station and the two 700 ft. long flanking hangars in the center of the new landing area. Demolition of these buildings, apparently, is planned.

Croydon, London's commercial airport, had a similar adventure, expansion of the landing area eventually isolating the original extensive airport buildings in the center of the expanded airport, these being demolished at a cost of $600,000 and new buildings costing over $1,000,000 being built, (but now found inadequate, it is said, to suitably accommodate present day airport traffic).

The simple expedient of following a well conceived comprehensive airport plan drawn up at the outset in the development of the airport, the cost of which would have paid for itself many times over, would have made these drastic and expensive revisions of existing airport facilities unnecessary.

The critical examination of these four airports has not been done to belittle the pioneering work already accomplished but to point out for those interested in airport development certain fundamental principles in the laying out of the airport which at the

present time appears to be lacking. Similar radical changes in airport layouts are taking place or are needed at practically all airports at important focal points of air and surface transportation.

Airport construction in the past has too frequently gone forward as though the grading, draining and surfacing of the airport landing area, the construction of runways, the placing and construction of airport buildings and the laying out of other essential parts of the airport were so many unrelated problems. All these elements, however, should be interdependent if the airport is to function smoothly as a unit. This co-ordination is only possible when they are conceived together and planned as parts of a closely knit whole.

Experience has shown that it is not enough to allow the airport to develop blindly month by month or year by year as occasion demands, thus leaving its ultimate developments to chance.

To attain the necessary unity for present needs and an ordered expansion for potential future air traffic the airport construction program should be based on a comprehensive, far sighted, flexible and well conceived master plan drawn up at the outset. Such a comprehensive early plan forms the very backbone and foundation of the whole airport program and largely governs the effectiveness of the capital invested.

Air Pilotage

(*Continued from page 27*)

fold with accordion fold to a convenient size so that the chart will show the course continuously by turning the next successive fold. Once in the air, keep a continuous look-out for landmarks and mark the plane's position with a circle and a notation of the time at every opportunity.

No two navigators will follow the same technique in accomplishing air pilotage. However, any skilled navigator will make the best possible use of all his faculties for checking observed landmarks with landmarks indicated on a chart, or mentally with landmarks already memorized. Direct visual observation, while the most important, is by no means the sole method of checking position. In addition to sight, the navigator should develop to the fullest his sense of smell, hearing (though in a plane this is difficult to use), and touch as applied particularly to his sense of temperature change. Furthermore, special attention should be given to following ranges, fixing position by bearings, and by distance from known objects observed. There are other means for fixing position approximately, such as the smoke from cities, night lights from cities seen at a distance as a glow, special cloud formations along the coast or over islands or mountains, and other indications which will doubtless occur to the reader when he gives full rein to his imagination.

Admittedly, some of the wrinkles noted above are somewhat far-fetched, and infrequently utilized, though it is the writer's conviction that the use of many different factors, perhaps subconsciously, by experienced navigators gives them what some people will consider "instinctive" ability, or the 'sixth sense'. The fact is an intelligent person can make far greater use than is commonly supposed of our known senses of sight, taste, touch, smell and hearing.

An example of practical application of the sense of smell is related by an Eastern Airlines pilot who tells of a fellow pilot who makes a safe approach at the Richmond Airport by first fixing his approximate position over the industrial plant at Hopewell, Virginia, by the sense of smell. Many have doubtless noted the odors peculiar to Curtis Bay, and other places. While not directly applicable to air navigation, the method of navigation on Puget Sound by "barking dog" navigation is an old story. It is a fact that marine pilots in that area when fog-bound sound their whistles, note the time for the echo to return and thereby are enabled to follow the tortuous channels or to keep at a safe distance from the shore.

Following *ranges* is perhaps the best practicable means for keeping on course and for assisting the navigator to identify landmarks. This is done by noting any two objects along the course and keeping them in line. As the nearest object is approached, a more distant object in line with the first two is selected, and the course altered so that the track of the plane will pass over the ranges. This procedure automatically allows for wind drift and thereby enables the navigator to follow his planned course with more precision. The closer the plane is to the course laid down on the chart the more easily a landmark may be recognized since similar landmarks several miles away will not be considered.

Railroads, transmission lines, rivers and shore lines may often be used as position lines. For example, a navigator flying from St. Paul to New Orleans may set a straight course to the west of the Mississippi river and need not follow the meandering of the river but only keep enough to the left to sight it occasionally. In this case the river would be an approximate north south position line, and the general course would be indicated by sighting the river, though the speed would not thereby be indicated. At some such point as the mouth of the Arkansas river the navigator would cross to the east bank and continue on to New Orleans. In the same way a mountain range, railroad or shore line might be used as an aid to navigation.

Some good general rules for cross-country flying are:

(1) Make careful preparations in advance.

(2) Keep a continuous check on the plane's position.

(3) Carry a good compass, and when in doubt steer a steady compass course. Avoid frequent changes in course when the position is uncertain, as these changes only add to the uncertainty.

(4) Practice map-reading until objects seen on the earth may be readily identified on a good map.

(5) When lost, use every means to get a fix (the plane's position) as quickly as possible. The more time that is lost in getting a fix the more difficult it becomes to do so.

It is no disgrace to get lost, but the efficient navigator will make every effort to reduce the period of uncertainty of position to a minimum. The moment the plane's position becomes uncertain, the hazards of flying rapidly increase and are normal only when the plane's position is once more definitely fixed. The longer the period of uncertainty, the more difficult it is to fix the position.

In this brief discussion no mention has been made of Navy Department Strip Maps, Rand-McNally Air Trails Maps, etc. Since many practical flyers will have difficulty in obtaining charts or special information or equipment for long-distance flying, further information will be given persons addressing the writer through this column or at Annapolis, Maryland.

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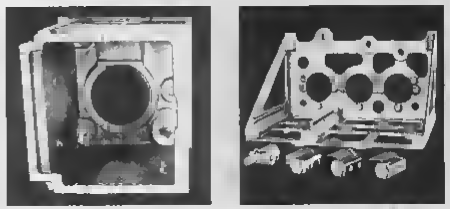

Above is the case for the Sperry Gyro-Horizon (Bank and Climb Indicator) and the mounting unit of the Sperry Gyropilot—both DOWMETAL castings

Kellett Type YG-1, U. S. Army Air Corps

AVIATION SCHOOLS

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FOR SALE OR TRADE. J5 Ryan Monoplane, just refinished. Will sell cheap or trade for 2 or 3 place open radial job. F. H. Crim, Manchester, Ga. No. 9

B17L—1935 Beechcraft equipment, 225 H.P. Jacobs engine—metal propeller, landing lights, flares, flight instruments. Color white, black trim. Demonstrator total hours approximately 250. Price $6,000. Air Travel and Sales, Inc., 9835 Yorkshire Road, Detroit, Mich. No. 10

RYAN SPEEDSTER J6-5. Three place, open cockpit, dual controls. 150 hours total time on plane. Wonderful shape. $1,500 cash. 5032 Hurlbut Avenue, Detroit, Mich. No. 11

"Classified" INDEX

June, 1937

PLANES, ENGINES PARTS FOR SALE

advertisements in this classification are numbered (end of last line each ad) for indexing

PRODUCTS:

See Numbers as follows

SERVICES:

See Classification and/or Numbers as follows

WANTED:

See Numbers as follows

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TRADE:

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POSITIONS WANTED:

See Classification

POSITIONS VACANT:

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EMPLOYMENT SERVICE:

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CHALLENGER COMMAND-AIRE, $1,000. Cabin Waco UIC radio, lights, flares, ambulance $3,300. Aeromarine seaplane with landing gear $800. Wasp J-5 and Challenger motor parts. Terms as low as one-third down. Airways, Inc., Waterville Municipal Airport, Waterville, Maine. No. 12

LEBLOND 7-cylinder 90 H.P. engine, no time since major, total time 355 hours $200.00. 3B2 S new B.G. radio shielded spark plugs $1.25 each. Pioneer Oil Temperature Gauges—guaranteed satisfactory, $3.00. 22x10x4 Goodyear air wheels, tires, tubes and brakes. Snyder Aircraft Company, Municipal Airport, Chicago, Ill. No. 13

BELLANCA SKYROCKET 450 h.p. Wasp C. Has everything. 80 hours since major overhaul. South American inquiries invited. W. B. Harding, Holmdel, N. J. No. 14

LYCOMING R-680. Complete with mags, carburetor, heavy duty crankshaft and forged pistons. 400 hours since majored. $395. Howard Sauls, Saltville, Va. No. 15

GYPSY MOTH—licensed to October. Repainted last winter. 400 hours—450 on engine just top overhauled. $575.00. Providence Airport, Seekonk, Mass. No. 16

FOR SALE. Landing gear parts for Travelair 2000. Also struts, flying wires. New and used. Used J-6 crankshaft and other parts. Amsterdam Flying Service, Inc., Amsterdam, New York. No. 17

1935 WACO CUSTOM CABIN, 320 H.P. Wright, just majored, controllable pitch propeller, 95 gal. gas tanks, landing lights, flares, Lear radio compass, Lear receiver, Sperry Horizon, directional gyro, Kollsman sensitive altimeter, bank and turn, manifold pressure, generator, starter, Jaeger Chronograph clock, total time 410 hours, price $5,000.00. Waltz Corporation, Central Airport, Camden, N. J. No. 18

REARWIN SPORTSTER, 90. Brand new. Undelivered. Will trade automobile and finance balance. Can furnish ship as you specify. J. Walter Sell, 366 Vine Street, Johnstown, Pa. No. 19

125 WARNER COMMANDAIRE 3 POLB just topped and new paint job. Hamilton steel prop, licensed, $700. H. R. Gustin, Pine City, N. Y. R. D. No. 1. No. 20

BIRD. 4-place, Kinner B-5. Bought from Keyport last May. The best ship of its kind in the country. Anyone interested in a real money-making ship for passenger hopping and instruction will buy this plane. Max Rappaport, Roosevelt Field, Mineola, N. Y. No. 21

Continued from page 80

FOR SALE WINGS—Waco F, Waco 10, J5, J65 Waco Cabin. Aeronca, Travelair, American Eagle. We are equipped to rebuild any wing in 24 hours after it arrives at our factory. N. L. Aircraft Co., Vermilion, Ohio. No. 22

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BARGAINS: Arrow Sport excellent condition, Gee Bee Model A, just relicensed, less than 300 hours. Motor parts for J-6 Challenger, Szekely, Axelson, OX, LeBlond, inertia starters, wings for Eaglerock and Waco. Accessories. Aviation Service Company, Inc., Hartford, Conn. No. 24

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FOR SALE. J69 Ryan B5 completely reconditioned. Recovered like new. Licensed till April 38—$1750.00. L. P. Quinn, Municipal Airport, Denver, Colorado. No. 27

TRAVELAIR S-6000-B, J-6-9 majored, wings recovered, stub masts installed, night flying equipment. Shielded. Photo drop in fuselage. Relicensed recently. Alsop Flying Service, Springfield Airport, Springfield, Mass. No. 28

FAIRCHILD 22 Cirrus inverted 95 H.P. Pioneer instruments has not been flown since recovered and engine majored, can be painted any color desired, price $1,650. Waltz Corporation, Camden, N. J. No. 29

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STRAIGHTWING WACO, J-6-7-majored, good fabric, Challenger Robin. Recent recover job, motor majored. Robin good condition. Taylor Cub 35 recent recover. Inquire now. Approved Repair Station #268. Springfield Airport, Springfield, Mass. No. 31

GREAT LAKES 2 T1A. Excellent condition. New motor. Air wheels. Price $985.00. Fredrick Lambach, 1102 Davenport Bank Bldg., Davenport, Iowa. No. 32

FOR SALE. 135 HP Warner, less than 500 hours. Price $500, plus crating charges. F. H. Pedrick, 480 May Street, Jacksonville, Fla. No. 33

WACO 1936 Custom cabin. Lights, flares, bank and turn, climb, clock, radio, pants, steel prop, large tanks, 5 places, Imperial blue with cream trim. 225 Jacobs, 11 months old, 160 hours. Never scratched, priced to sell, cannot be told from new ship. Dixie Airways, Inc., Shushan Airport, New Orleans, La. No. 34

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(Continued on page 92)

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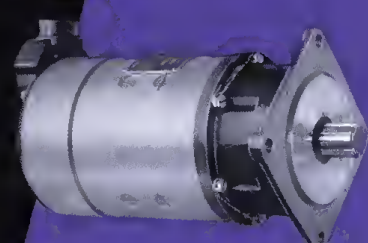
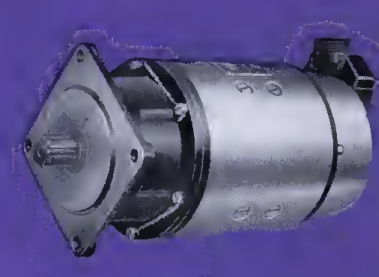


TYPE G — 225 Watt — Engine Driven Generator available for 12 volt battery charging



TYPE D — 375 Watt — Engine Driven Generator available for 12 volt battery charging